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ABSTRACT

This guide is Missouri's primary resource for planning, implementing, and evaluating Industrial Technology/Technology Education (ITE/TE). It contains 10 chapters: (1) a direction for ITE/TE; (2) planning the ITE/TE program; (3) planning ITE/TE facilities; (4) implementing a safety program; (5) creating ITE/TE's image (public relations); (6) teaching ITE/TE; (7) organizing and managing the ITE/TE program; (8) evaluating ITE/TE; (9) meeting professional responsibilities; and (10) helpful resources. A list of 138 figures and 3 tables is included. Chapter 10 contains an index of forms, an index of 72 Technology Activity Modules, and recommended ITE/TE competencies and articulation links depicted in graphic form. (NLA)

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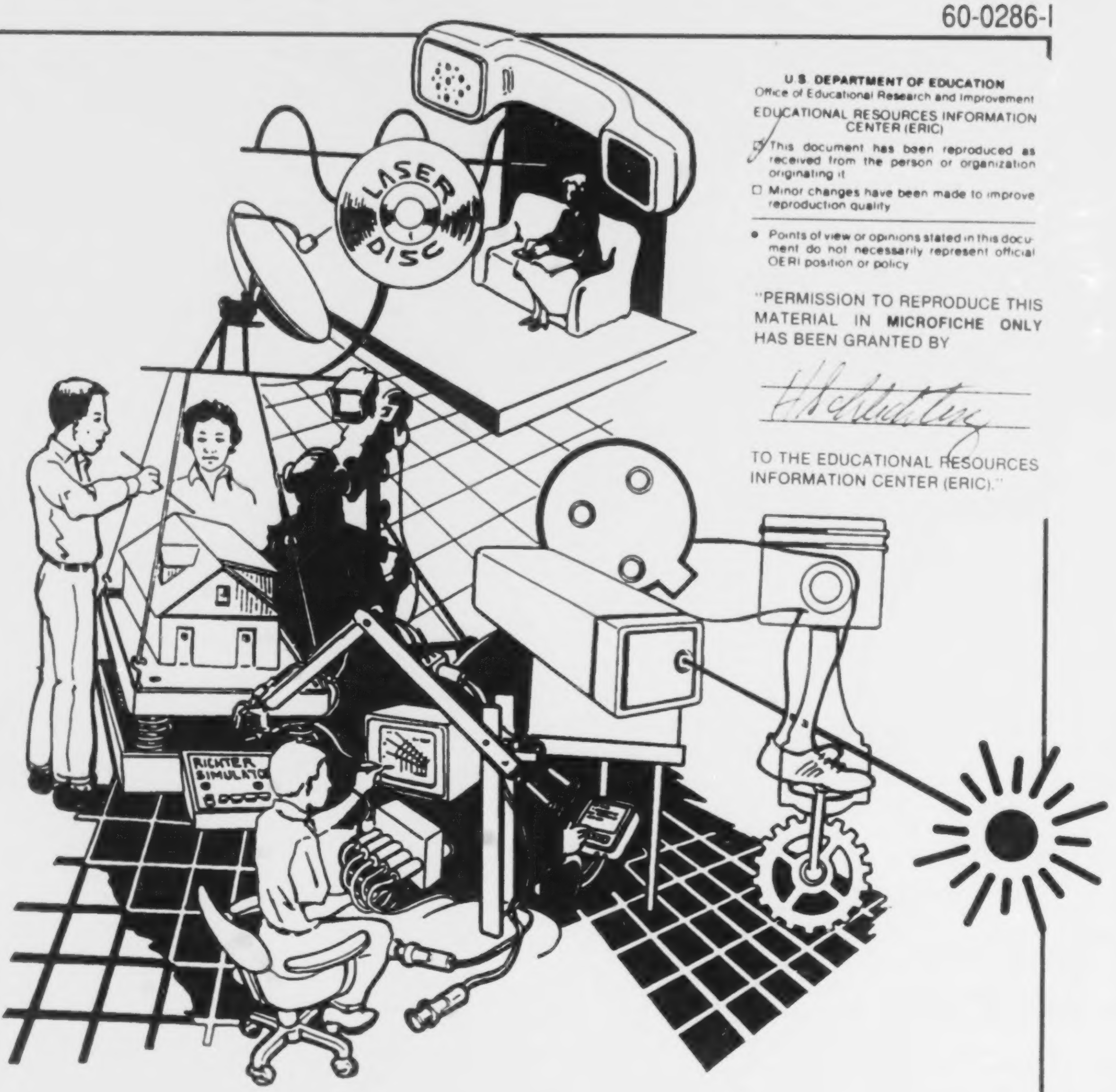

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Missouri
Industrial Technology/Technology Education Guide

DEPARTMENT OF ELEMENTARY AND SECONDARY EDUCATION

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1991 Industrial Technology/ Technology Education Guide

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Missouri

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Acknowledgements

First and foremost, this 1991 revision of the *ITE Guide* is a tribute to professionalism, to the faith and dedication of Missouri's Industrial Technology education profession—its individuals and its association—the Missouri Industrial Technology Education Association. This revision represents the culmination of an important phase of ongoing professional improvement that is so necessary to keep the technological education of Missouri's youth current.

But professions are not anonymous groups of people. Instead they are comprised of many individuals who give up untold amounts of their time and energy. Clearly the members of the project's original and current advisory committees, as named on the frontispieces, are prime examples of such dedication. In many ways this *Guide* is more a product of their insights than those of the project writers. The members of the project's advisory committees made significant contributions by helping insure that the *Guide's* recommendations were, above all, **feasible** for implementation in Missouri's varied school settings.

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Michael J. Dyrenfurth
June 1991

Foreword

This *Guide*, as was its predecessor, is dedicated to the improvement of Industrial Technology/Technology Education in Missouri and to all of the dedicated instructors who work hard at this challenge each day! As such, this *Guide*:

- **is intended to be the state's primary resource for planning, implementing and evaluating industrial technology/technology education,**

- **is further intended to provide guidelines for organizing, instructing, and managing such programs, and**

- **is also designed to help direct industrial technology/technology educators to references where they can find additional information.**

The *Guide* should meet the needs of teachers and administrators by presenting highlights of the best thinking and practice. With the talents and efforts of Missouri's many practitioners, and the suggestions contained in this *Guide*, we look forward to the creation of a broad base of exemplary programs that will help Missouri's youth learn much about their technological world!

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CHAPTER I

A DIRECTION FOR INDUSTRIAL TECHNOLOGY/ TECHNOLOGY EDUCATION

SOCIAL CONTEXT

RELATIONSHIPS TO
GENERAL AND
VOCATIONAL EDUCATION

A DIRECTION FOR
INDUSTRIAL TECHNOLOGY/TECHNOLOGY EDUCATION

Chapter I

A Direction for Industrial Technology/Technology Education

1. Introduction & Overview

This chapter, as the Missouri Industrial Technology/Technology Education (ITE/TE) Guide's first, anchors the entire profession's practice. It lays the foundation upon which all subsequent chapters are built.

Objectives

1. To provide the profession with a clearly worked out statement of philosophy and rational clarifying the context and nature of technology, Industrial Technology and Technology Education.
2. To highlight the specific missions and goals of ITE/TE.

Chapter 1 Outline

1. Introduction & Overview 1
2. Philosophy of ITE/TE 1
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2. Philosophy of ITE/TE

Missouri's industrial technology/technology education profession affirms that its programs should teach about technology and use industrial technology **in a way that serves as a vehicle to build understanding, skills, and attitudes that can be generalized and applied to technology in general**. Furthermore, because all people are affected by technology, and because of technology's increasing presence in our lives, a minimum of a one semester course in industrial technology/technology education is recommended for all of Missouri's middle school, junior high and high school youth.

Technology and Industry

But what is technology? Simply stated, it is humankind's use of tools, machines, materials, processes and energy to satisfy its wants and needs. As such, it is not the search for an explanation of why things work—that is science. Nor is technology merely applied science—because often it precedes scientific knowledge.

Technology is knowing "how" to do something with tools, machines, materials processes and energy—and then it necessarily involves being able to do. Mere knowledge is not sufficient. Rather, technology is a combination of knowledge, skills and attitude that is always more powerful than any single faceted competency.

Industry is one of humankind's basic institutions. As such, it parallels that of government, church, and education. It is that institution that supplies our civilization with goods and services to fill our wants and needs. It does so by using technology. The technology used by industry, is typically referred to as industrial technology.

Social Context

Contemporary and future society are clearly different from what America experienced during its first industrial revolution. To be sure, some elements of the industrial revolution remain, but many more have changed. Technology as a force has affected most aspects of our life, and thus technology seems to be the single most distinctive characteristic that sets today and the future apart from our past.

Evidence of this is seen in the literature. Note, for example, the frequent references to the *post-industrial* society, to the demise/reduction of *smoke stack* industry and to the *information* society. Furthermore, we have seen tangible evidence of such shifts in our automotive, steel, petroleum and electronics industries.

Technology as a force has affected most aspects of our life.

Business and industry have been required to grapple with technology engendered issues such as productivity, technological capability and global competitiveness. Their workers have been challenged to retrain to develop currently marketable skills—in cognitive, affective and psychomotor domains—in order to maintain their ability to support themselves and contribute to our free-enterprise economy. Furthermore, with technology's advances, America's workers find these skills to be constantly changing.

Legislators have also been pressed to understand technology and its effects as they work to frame policies for the public good. With the rampant escalation of both the amount and complexity of technology, it is increasingly difficult for people to exercise appropriate citizenship functions, particularly given the curtain of confusion raised by technology and its media offspring.

Consequently, citizens have often found themselves bewildered by increasingly complex consumer decisions. Frequently they face decisions involving trade-offs between immediate gain for long-range unknowns or even known, but preferably ignored, negative consequences, e.g. the effects of toxic wastes. Similarly, recreational environments and activities have increasing technological components, as do personal and societal learning activities.

Technology's pervasive influence has permeated even our homes. Our lifestyle is timed, microwaved, accelerated, recorded, computerized and confounded. A greater proportion of people are working, families are resorting to schedules to program their contact and others are unemployed due to technological advances. Outside knowledge is pouring into the home via television and other media. Not infrequently the tensions from external aspects of life, many of which are technologically induced, do come home in the form of stress.

Even in social service arenas such as the health sciences, technological capabilities have caused us to ponder when enough is enough. We ask, for example, to what end do we operate life support systems in situations currently deemed hopeless?

Implications for Education

Given the pervasive nature of technology, the industrial technology/technology education profession raises the question: ***"Where do people develop the understanding, skills and attitudes to deal with forces such as technology?"*** This guide's response is straightforward. Clearly our society uses formal schooling as a principal method to this end—at least for youth, and in increasing numbers, for adults.

It follows then that one must ask, ***"What are the schools doing to help youth and adults address technology's challenges?"*** What systematic efforts are in place to develop technologically appropriate understanding, skills, and attitudes in elementary, secondary, postsecondary, adult and continuing education?

This guide presents an overview of how Missouri has addressed this responsibility—directly, efficiently, and effectively through its ITE/TE program! To this end, the *Missouri Industrial Technology/Technology Education Guide* is intended to be the state's primary resource for planning, implementing and evaluating industrial technology/technology education. Therefore it provides guidelines for the organization, instruction and management of ITE/TE programs and associated student organization (e.g., Technology Student Association [TSA]) activities. The *Guide* also directs industrial technology/technology education educators to references where they can find additional information. The *Guide* was developed to meet the needs of teachers **and** administrators by presenting highlights of the best thinking and practice supportive of efforts to create exemplary programs that help Missouri's youth learn about their technological world.

> **The Missouri Industrial Technology/Technology Education Guide is intended to be the state's primary resource for planning, implementing and evaluating industrial technology/technology education.**

ITE/TE's Relationship to Vocational and General Education

Given the context described in the previous sections, it is clear that ITE/TE must be an essential component of **BOTH** general education and vocational (specialized) education. Only in this way can industrial technology/technology education:

1. Serve as the component of general education that develops generalizable understandings, capabilities, values and attitudes related to technology in all youth.
2. Serve as a component of specialized education that contributes to meaningful occupational choice and/or preparation in a technological society.

Because of these dual dimensions and because of ITE/TE's approach, it has an essential role in helping build the base that leads to successful articulation plans such as Tech-Prep and/or 2 + 2 or 2 + 2 + 2 programs. Professional leaders need to be alert to opportunities to further the program's contributions to Missouri's youth as enabled by the recent Carl D. Perkins Vocational and Applied Technology Education Act.

The Profession's Name

Technology, industrial technology and industrial arts educators have, since at least 1904, addressed the content of industry. More recently, since the late 70's there has been considerable professional impetus to redefine the subject as dealing with technology instead of with industry. Technology is viewed as more broad than industry or even industrial technology. Missouri's teachers have accepted well the first step of such a transition, namely to move from industrial arts to industrial technology/technology education. Currently, their view is that they are teaching the essentials of technology using an industrial context—primarily because their laboratories and background are more suited to this field. In essence, the position is that **even if the field's name is industrial technology, the core of their instruction focuses on the basic skills and understandings of technology**—only they use industry-oriented settings to accomplish this.

This guide is dedicated to helping Missouri's industrial technology/technology education programs reflect technology, industry, and professional practice with greater fidelity. Consequently, it incorporates the profession's recommendation that either of its new names ***technology education*** or ***industrial technology education***, be used to communicate the primary intent of the program.

Technology is more broad than industry or even industrial technology.

Content

Although in our material and technological society not everyone is a producer, all are consumers and users of the products of industry and its technology. Therefore, **industrial technology education** as a school program draws its content from industry and the technology industry uses to achieve its ends. **Technology education** draws its content from the entire range of technological endeavor, not just industry. In both approaches, content is also selected by identifying the competencies individuals need to effectively use the products of a technological society.

Given the preceding philosophy and foundation, it is clear that the educational program known as **industrial technology education** derives its content, i.e. the subject matter it teaches, from industry and technology. More specifically, this program focuses on the technology which industry uses to accomplish its ends. Obviously, this content is called industrial technology. It often is considered to be a body of knowledge or a discipline.

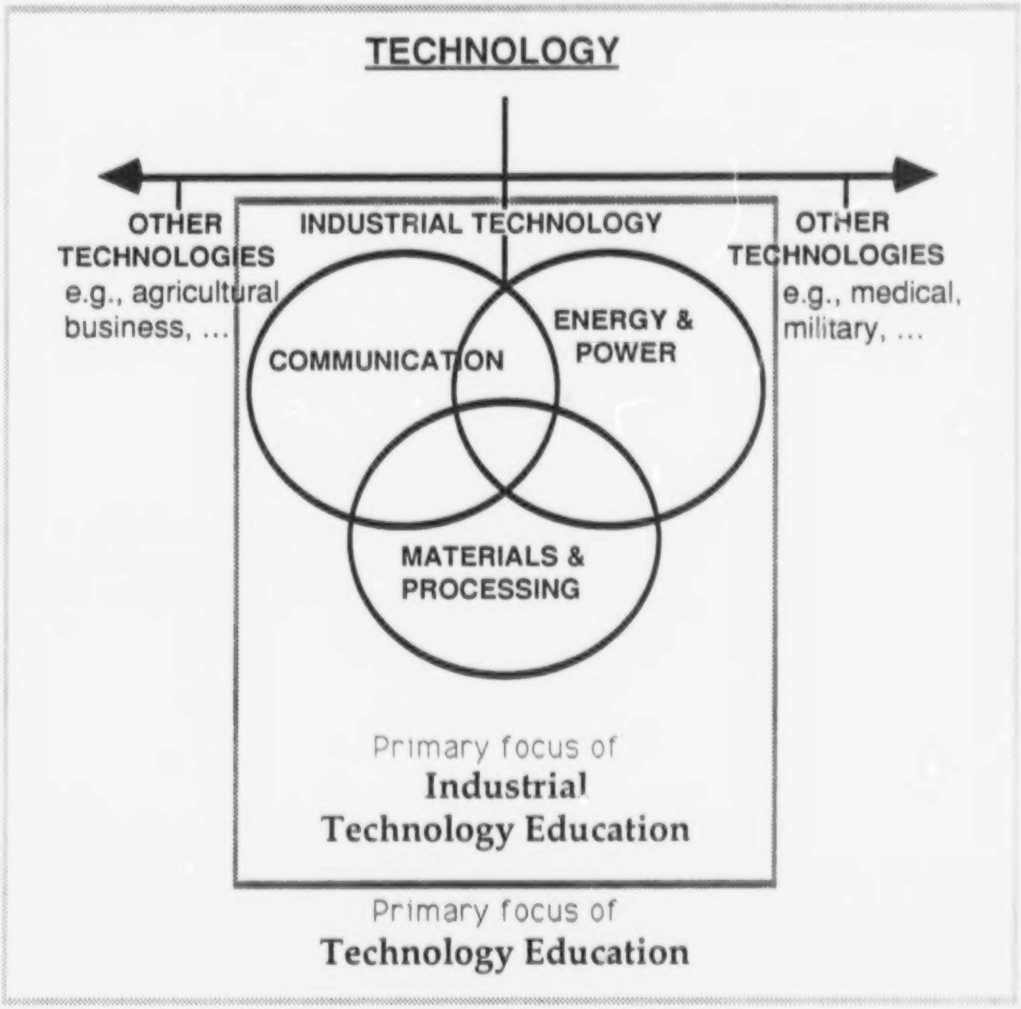
Although in our material and technological society not everyone is a producer, all are consumers and users of the products of industry and its technology. Therefore, industrial technology education as a school program draws its content from industry and the technology industry uses to achieve its ends.

As such, industrial technology is a subset of technology as shown by Figure I-1 and much of it can be generalized to technology. To clarify, note that:

1. **Industrial technology is that technology which is used by industry. As such, industrial technology coexists with agricultural and other technologies.**
2. **Industrial technology consists of three system clusters; Materials & Processing, Energy & Power, and Communication.**

Figure I-1

Relationship of Technology to Industrial Technology


TECHNOLOGY
OTHER TECHNOLOGIES
e.g., agricultural, business, ...
INDUSTRIAL TECHNOLOGY
OTHER TECHNOLOGIES
e.g., medical, military, ...
COMMUNICATION
ENERGY & POWER
MATERIALS & PROCESSING
Primary focus of
Industrial Technology Education
Primary focus of
Technology Education

3. **Industrial technology education focuses on the technology of industry.**
4. **Technology education focuses on all of the technology used by humankind.**

Figure I-2

Missouri Industrial Technology Education Program Goals

Every student participating in any implementation of industrial technology education will experience a systematically designed and delivered program of instruction and activity that:

1. Develops an understanding of, and capability with, industrial technology—its processes, materials, equipment and products.
2. Develops an understanding of the practical applications of mathematic, scientific and technological principles to industrial processes.
3. Develops basic skills in the safe use of tools, machines and processes used by industry and technology.
4. Develops technological problem-solving skills and attitudes.
5. Fosters creativity in using technology for desirable purposes by encouraging students to create, from materials and with technological processes and hardware, new and different forms which have greater or alternative value.
6. Contributes to meaningful occupational choice by developing an understanding of industrial and technological career opportunities and their requirements.
7. Facilitates the discovery of individual talents, aptitudes, interests and potentials related to industry and technology through laboratory activity.
8. Encourages cooperative attitudes, constructive work habits and other traits that will help secure and maintain employment.
9. Engenders pride in work done well.
10. Develops consumer skills related to the appropriate production, consumption and maintenance of technological goods and services.
11. Reinforces general education's basic skills, and contributes to advanced education, by providing practical and motivating applications of basic knowledge, attitudes and skills.
12. Prepares for entrance into advanced secondary and post-secondary vocational/technical programs by promoting the development of a basic foundation of occupational skills and interests.
13. Provides an alternative learning mode for those who learn better in settings other than the conventional classroom.
14. Encourages the development of attitudes reinforcing the free enterprise system.
15. Stimulates leadership behavior by student organization activity.

3. Mission and Goals of ITE/TE

Since industry and technology are distinctive characteristics of American culture, and since one of the key purposes of education is to transmit the culture to future generations, it follows that it is necessary for the schools to provide youth with an insight into, an understanding of, and selected capabilities with, the technological nature of this society. Industry and technology spring from the human ability to reason, solve problems, create, construct, and use materials, tools, machines and processes imaginatively. Because these abilities are an integral part of our technological culture they should be developed in all students—regardless of their educational goals or occupational aspirations.

The overarching mission of ITE/TE as a school program is to develop the human potential of all students for responsible work, citizenship and leisure roles in a technological society. To accomplish ITE/TE's designated educational roles, programs must systematically address each of its three primary missions, namely to:

The overarching mission of ITE/TE as a school program is to develop the human potential of all students for responsible work, citizenship and leisure roles in a technological society.

1. **Develop each person's ability to comprehend and apply the concepts of industrial and technological systems.**
2. **Develop each person's values and attitudes related to the appropriate use of industrial technology—its tools, machines, materials, processes and products.**
3. **Develop each person's ability to use materials, technological processes and hardware to achieve constructive work skills and enhance occupational opportunity.**
4. **Develop each person's integration of basic skills in all they do.**

ITE/TE addresses these four primary missions by purposefully working towards an important set of goals. Simply put, this means that every student participating in any implementation of the industrial technology education program should experience a systematically designed program of instruction and activity that accomplishes each of the 15 goals presented in Figure I-2.

As such, ITE/TE operates within the context established by the Missouri State Board of Education's statement of educational goals, highlights of which are shown in Figure I-3. By articulating carefully to such state goals, ITE/TE instructors can enhance the perceived value of their programs and they can increase the program's contribution to youth. The competency articulation charts in Chapter 10 facilitate this task.

Figure I-3

Educational Goals for the State of Missouri[1]

It is the belief of the State Board of Education that one of the fundamental rights of each individual is the right of equal access to educational opportunity—regardless of race, creed, or socioeconomic status...The product of such a system must be an individual who is adequately prepared to enter the next sequential phase of life—one who can readily adapt in a dynamic and rapidly changing society...Although these goals are categorized for convenience, a single category or combination of categories should not be interpreted to be mutually exclusive...

I. Intellectual Development

It is the goal of the State Board of Education that each individual will have the opportunity to develop his/her intellectual ability to the extent of his/her developmental capacity. The development of intellectual ability should include not only the acquisition of knowledge, but also the creative ability to process and use that knowledge so that each individual becomes a literate and worthwhile member of society.

The State Board of Education believes that each individual must become proficient in communication, quantitative thinking, social processes, scientific understanding, decision making, and aesthetic appreciation in order to acquire the desired knowledge and fundamental intellectual processes.

. . .

II. Physical Development

It is the goal of the State Board of Education that each individual will have the opportunity to develop knowledge, understanding, and/or skills in the processes of physical growth and maturation, health and recreation to the extent of his/her developmental ability.

. . .

III. Social Development

It is the goal of the State Board of Education that each individual will have the opportunity to develop social skills to the extent of his/her developmental ability. These skills should be related to the individual's physical and social environment, cultural awareness, governmental institutions avocational pursuits, and concept of self, morality and values.

. . .

IV. Career Development

It is the goal of the State Board of Education that each individual be provided with systematic and sequential activities at all levels to facilitate educational-occupational decision making appropriate to his/her state of maturation. These activities should be related to the social significance of work, occupational exploration, occupational preparation, and adult occupational education.

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[1] ________. *Educational Goals for the State of Missouri.* Jefferson City, MO: Missouri Department of Elementary and Secondary Education, n.d., pp. vi-ix.

4. Quality Control

ITE/TE instructors often benefit from outside review of the logic in assembling their programs. This review can be as sophisticated as procedures outlined in Chapter 8 of this guide or it can be as simple as a self-assessment of how well the National and State ITE Standards are met. To this end, the program philosophy standards are provided in Figure I-4.

Figure I-4

MOITE Standards, Topic 1: Philosophy

Industrial technology education programs depend upon a quality statement of philosophy as being critical to the success of the program. It must be written carefully to ensure that the ultimate goal, that is, comprehending our technological culture, is the basis for all content and instructional strategies. The statements contained within this standard topic concern the philosophy of a technology education program. A philosophy is a statement of fundamental beliefs which reflect a value system. It serves as a foundation and framework for all elements of a program.

Fill in marks to indicate assessment: ∇ **not met,** 0 **met,** Δ **exceeded**

1. The philosophical statement is written and on file. (Note: if the response is "no", then standards 2-17 should also be marked "no".) .... ∇ 0 Δ
2. The philosophical statement is consistent with local, state, and national philosophies of education and of industrial technology/technology education. .... ∇ 0 Δ
3. The philosophy describes the industrial and addresses the technological nature of society in the past, present, and future. .... ∇ 0 Δ
4. The philosophy identifies the needs, abilities, and interests of all learners, regardless of race, sex, creed, national origin, or handicapping conditions. .... ∇ 0 Δ
5. The philosophy addresses the value of a comprehensive industrial technology/ technologyeducation program program including: industrial and technological literacy; career orientation, exploration, and preparation; avocational activities; economic concepts; consumer skills; creative talents; personal and social growth; and problem solving skills. .... ∇ 0 Δ
6. The philosophy encourages development of personal and leadership skills through TSA or local program student clubs. .... ∇ 0 Δ
7. The philosophy focuses upon the broad categories of communication, construction, manufacturing, and transportation at all educational levels. .... ∇ 0 Δ
8. Other teachers, interested in and knowledgeable about technology education, provide input for the philosophical statement. .... ∇ 0 Δ
9. Administrators and supervisory personnel responsible for local industrial technology education programs provide input into the philosophical statement. .... ∇ 0 Δ
10. Students, including local Technology Student Association (TSA) chapter members or local club members, are involved in developing the philosophical statement. .... ∇ 0 Δ
11. Parents, business and industry representatives, and other consultants are allowed to provide input into the philosophical statement. .... ∇ 0 Δ
12. The philosophical statement is a basis for program planning.and development .... ∇ 0 Δ
13. The philosophical statement is a basis for program implementation. .... ∇ 0 Δ
14. The philosophical statement is a basis for program evaluation. .... ∇ 0 Δ
15. The philosophical statement is reviewed annually.and revised as necessary .... ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): — — —

5. Resources

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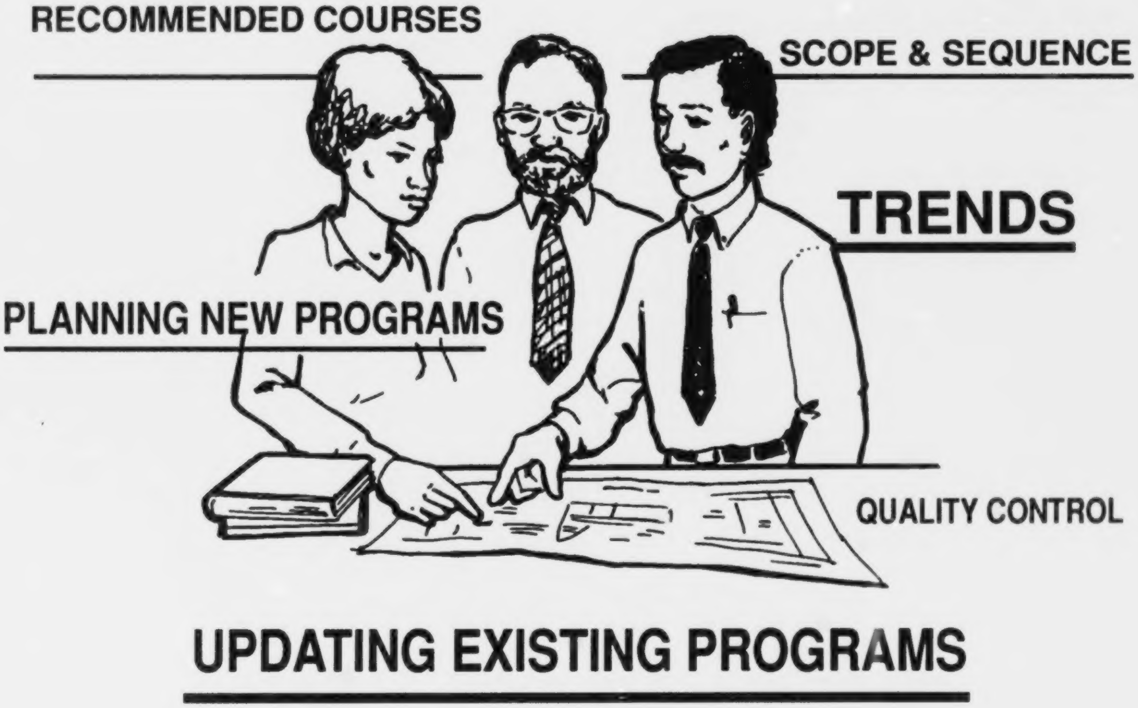
CHAPTER II

PLANNING THE ITE/TE PROGRAM


RECOMMENDED COURSES
SCOPE & SEQUENCE
TRENDS
PLANNING NEW PROGRAMS
QUALITY CONTROL
UPDATING EXISTING PROGRAMS

Chapter II

Planning the ITE/TE Program

1. Introduction & Overview

Overview

Chapter I described the challenges facing our profession and it provided a foundation upon which the profession can build as Missouri moves to reshape its industrial technology program into a technology program that even better meets student needs in this and future times. This chapter provides guidance in how to plan the needed reshaping.

As such, it is important to note the guiding principles for such reshaping, as established by Missouri's ITE/TE teachers, teacher educators, the Industrial Arts Study Project and the Missouri State Supervisor of Industrial Technology Education. These principles state:

- Existing programs and faculty offer much that can be built upon to create a better future.
- It is better to evolve than to make a drastic change.
- We do not need to scrap everything in our current industrial technology/arts programs in order to adapt to the demands of our technological world.
- The recommended ITE/TE program can be offered in existing (but updated) industrial arts facilities and by existing (but responsive) industrial technology/arts teachers.

Chapter 2 Outline

1. **Introduction & Overview 1**
2. **Recommended Scope & Sequence for ITE/TE 3**
3. **Recommended Courses for ITE/TE 6**
4. **Revising/Updating Existing Programs... 20**
5. **Starting New ITE/TE Programs 23**
6. **Program Planning Quality Control............................ 26**
7. **Documenting the Curriculum........ 29**
8. **Resources 62**

Objectives

1. To encourage the development of systematic ITE/TE programs in concert with state recommendations.
2. To promote implementation of ITE/TE courses.
3. To provide a series of recommendations for the updating of existing ITE/TE programs or the development of a new one.
4. To ease curriculum development by providing standardized TAM and lesson plan forms and explanations.

Figure II-1

Industrial Technology/Technology Education's Scope & Sequence: Essential Program Components

Grade	Level		Course	Logic
10-12	IV	Analysis & Synthesis	Any analysis and synthesis course	One of these courses
				And
9-12	III	Initial and Intermediate Cluster Competency Mastery	Intro. to Communication Technology Intro. to Materials & Processing Technology Intro. to Energy & Power Technology	All of these courses
				Or
			Exploration of Technology/Industrial Technology	This course
				And
6-9	II	Foundation Building	Introduction to Technology/Industrial Technology	This course is the minimum required in a program
K-6	I	Awareness	Elementary School Technology Education Infusion Activities	Recommended but optional

2. Recommended Scope and Sequence for ITE/TE

A detailed study of Missouri's industrial arts programs and state and national trends was conducted during 1985-86 (Dyrenfurth, 1986). This project yielded a scope and sequence for Industrial Technology/Technology Education that is **responsive** to the technological and societal demands of our world. Since then the profession has continued to evolve and it is now making the transition to technology education. The ITE/TE's scope and sequence reflects the profession's "state-of-the-art" in programming and it does so in a way that is **feasible** given Missouri's wide range of school sizes and environments. The recommended scope and sequence is shown in Figure II-1.

Explanation of Scope and Sequence Levels

1. Missouri's industrial technology/technology education program, structured as shown in Figure II-1, is carefully designed to follow the natural pattern of student development. It does this by guiding students through a series of courses that follow the stages of Awareness, Foundation Building, Initial and Intermediate Cluster Mastery, and Analysis & Synthesis.
2. Level I promotes technological awareness by infusing a set of technology-based learning activities into the regular ongoing elementary school curriculum. These activities should be designed to enhance mathematics, science and social studies curricula with practical technology-oriented applications. One or more of the school's or system's ITE/TE teachers should be assigned, for a specific number of periods, to serve as resource person(s) to support this infusion.
3. Level II builds an understanding of technology by means of one or more, Introduction to Technology/Industrial Technology courses. It is recommended that this course be required of ALL students in each of Missouri's school systems. The course needs to be a minimum of a semester in length and it must involve a systematic overview of the most important tools, machines, materials and processes of technology/industrial technology. This course must sample the key elements of each technological cluster and it must **not** focus on any single cluster. Where interest and/or enrollment warrants, this course may be repeated at higher grade levels, and students may enroll again in subsequent years. This course is intended to serve as a prerequisite to all other industrial technology/technology education courses.
4. Level III builds on the understanding of technology developed in Level II by moving into initial and intermediate competency mastery in each cluster. These clusters are:
    - Materials & Processing Technology. Study of this cluster involves the tools, machines, materials and processes involved in manufacturing, constructing and/or servicing goods. Typically it focuses on metallic, organic (woods, plastics and biological) and ceramic materials.
    - Communication Technology. Study of this cluster involves the tools, machines, materials and processes involved in transferring ideas and information from one place to another. As such, it involves all combinations of human—machine communication. Typically it focuses on electronic communication, graphic arts, engineering graphics and photography.

- Energy & Power Technology. Study of this cluster involves the tools, machines, materials and processes involved in converting energy, transferring power and instrumenting and controlling such processes. Typically it focuses on electricity/electronics, computers, engines and motors, instrumentation and control systems.

Note that Level III can be implemented using several different curriculum patterns. As shown in Figure II-2, one or more separate courses in each technology cluster or one course spanning all three technological clusters and entitled Exploration of Technology/Industrial Technology may be offered. To achieve the goals of Level III, it is recommended that if multiple courses within any single technology cluster are offered, they must include a prerequisite quarter or semester course spanning the breadth of that cluster. Subsequent courses within the cluster may reflect any appropriate subset of that technology. As shown in Figure II-2, after taking the first course in any cluster, students may:

a. Take any second-level course in that cluster.
b. Take the first course in any other cluster.
c. Advance to take any Analysis & Synthesis course.

5. A complete industrial technology/technology education program must offer one or more courses at the Analysis & Synthesis level (Level IV). These are designed to build analytical, synthesis and higher-order thinking skills. For example, a Research and Development course might investigate the nature of metallic, synthetic and organic materials and testing procedures. Students could also apply previously learned capabilities to the challenges of our free enterprise system. In such a course, students could design a product or service, establish and finance a company, produce the product or service and then market it. Alternatively, courses at this level could be designed to build in-depth knowledge for vocational or pre-technical preparation.
6. Level III's Technology Specialization courses in each system/cluster, as shown in Figure II-2, may also be taught at the Analysis & Synthesis level at local option. These specialization courses are best taken after an initial system/cluster survey course.

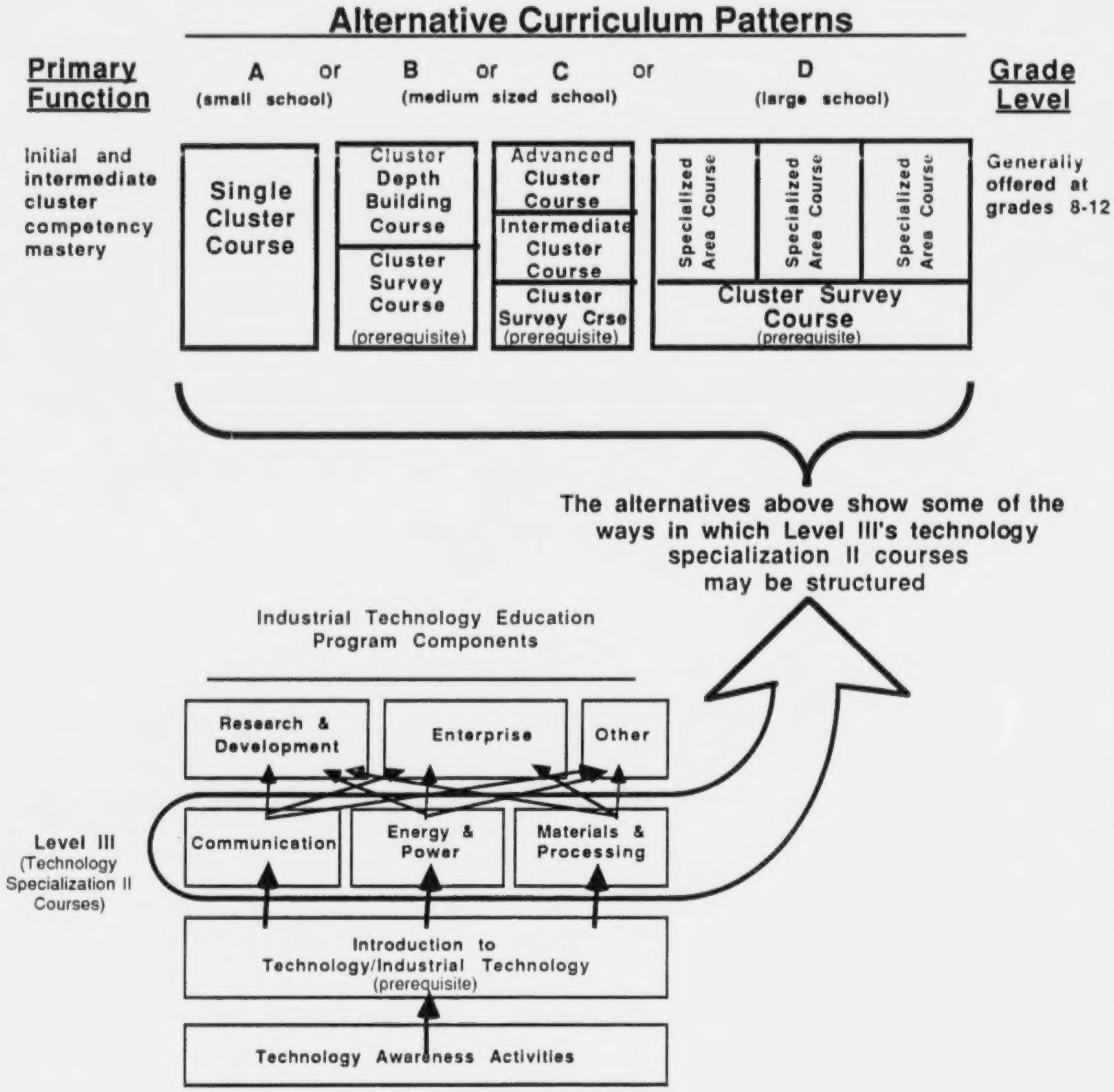
Characteristics of Quality Scope & Sequence Statements

To maximize the quality of ITE/TE programs, it is recommended that each school establish its own scope and sequence. Furthermore, each local scope and sequence should be carefully designed to be compatible with the design principles listed previously. In doing so, the school needs to consider its overall enrollment, level of support and the nature of its community and industry. As a minimum, however, every industrial technology/technology education program must include the components previously shown in Figure II-1.

1. To be complete, each local scope and sequence should document:
   - The course names and content that comprise the program.
   - The pattern of student flow through these courses (show prerequisites).
   - The range of grade levels at which each course is offered.
   - Which students are to be served.
   - The interface between the ITE/TE program and other curriculum areas.

Figure II-2

High School Curriculum Options for Offering Level III Industrial technology/technology education Cluster Courses


Alternative Curriculum Patterns
Primary Function
A or B or C or D
(small school)
(medium sized school)
(large school)
Grade Level
Initial and intermediate cluster competency mastery
Single Cluster Course
Cluster Depth Building Course
Cluster Survey Course (prerequisite)
Advanced Cluster Course
Intermediate Cluster Course
Cluster Survey Crse (prerequisite)
Specialized Area Course
Specialized Area Course
Specialized Area Course
Cluster Survey Course (prerequisite)
Generally offered at grades 8-12
The alternatives above show some of the ways in which Level III's technology specialization II courses may be structured
Industrial Technology Education Program Components
Research & Development
Enterprise
Other
Level III (Technology Specialization II Courses)
Communication
Energy & Power
Materials & Processing
Introduction to Technology/Industrial Technology (prerequisite)
Technology Awareness Activities

2. The scope and sequence for Industrial Technology/Technology Education is built from a list of courses provided in part 3 of this chapter.
3. For each Industrial Technology/Technology Education course, regardless of content, focus or level, instructors should develop a systematic plan to address the interface between the content and objectives of that course and those of:
    - Mathematics (core competencies & key skills)
    - Science (core competencies & key skills)
    - Social studies (core competencies & key skills)
    - Oral and written communication (core competencies & key skills)
    - Careers in the field
    - Other areas such as computer technology and ethics
4. Quality ITE/TE program scope and sequence statements will systematically incorporate careful articulation plans and agreements that facilitate student movement to advanced educational opportunities offered by vocational, technical or college institutions; the world of work and/or other opportunities such as entrepreneurship. The articulation plan shows how the program contributes to, and articulates with, advanced colleges, vocational, technical and post-secondary educational opportunities as well as to the world of work.

3. *Recommended Courses for ITE/TE*

An entire spectrum of courses is available to implement the ITE/TE program according to the recommended scope and sequence. Officially they are listed in the *Core data collection system manual* as issued by MO DESE. Their essence is summarized here. Note this list is only a recommendation. Where local planning and professional judgment propose a better scope and sequence, an alternative course may be offered. This option is particularly useful—even encouraged, to tailor offerings to specialized student objectives and/or to local industry/technology situa-tions. Additionally, each of the recommended courses in Level II and III may be tailored to suit the needs of any specific age/student group or grade, 6 - 12, and Level III courses may also be taught as Level IV courses with appropriate changes in their instructional approach. The overall pattern of courses by levels is shown in Figure II-3.

Level I: Awareness Courses

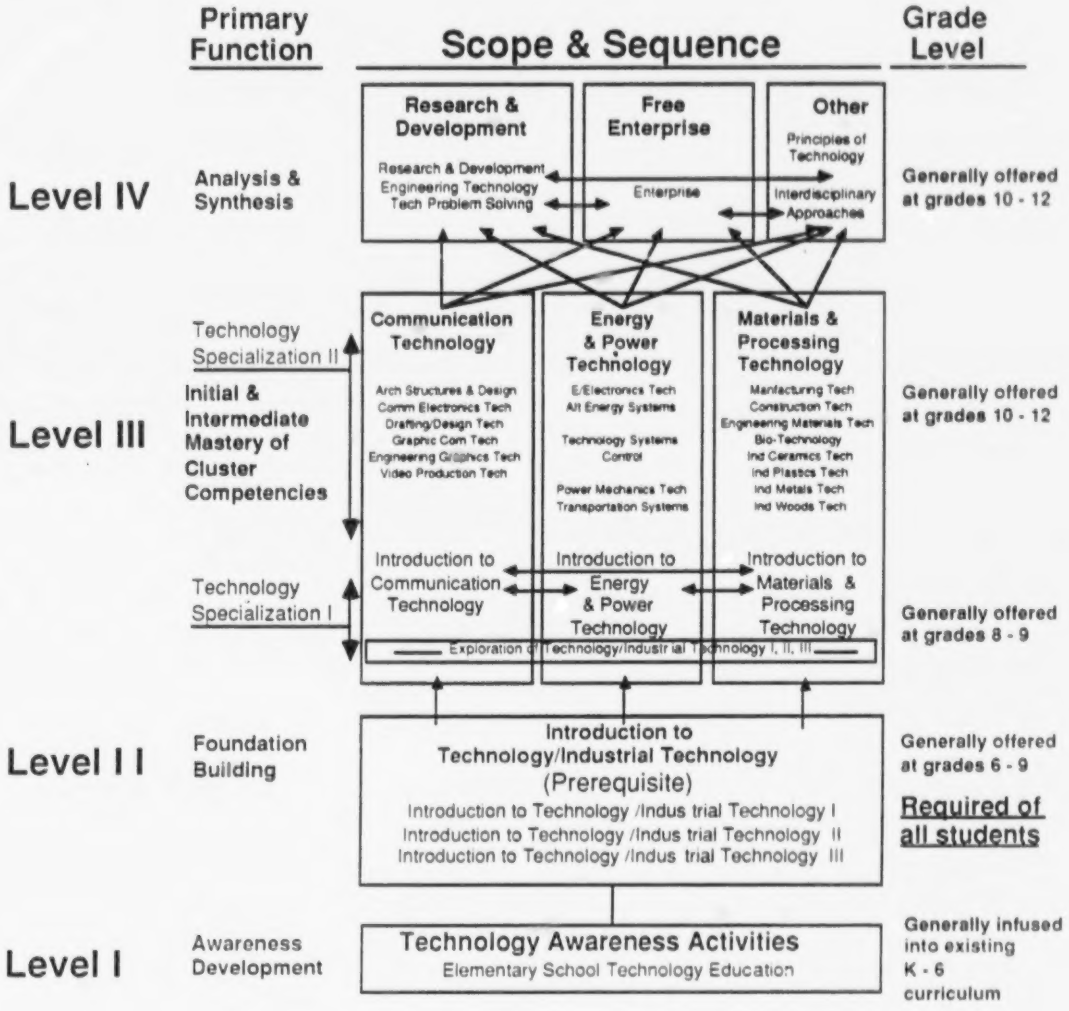
• Elementary School Technology Education EL TEC K-6 C & D 105400 Grades K-6	This course develops an initial awareness of the technological world. It provides opportunities for exploring, manipulating and planning with tools, materials and processes by using technological activities that reinforce basic mathematics, science and social studies skills.

Level II: Foundation Building Course

• Introduction to Technology/Industrial Technology I, II, III IN TEC 6-9 C & D 105405 Grades 6-9	This course develops a foundation of technological understanding and capability that provides an overview upon which future courses can build. Students systematically survey energy & power, materials & processing, and communications technology with demonstrations and practical activities that develop understanding, attitude, skill and problem-solving capability.

Figure II-3

Recommended Industrial Technology/ Technology Education Courses by Levels


Primary Function
Scope & Sequence
Grade Level
Level IV
Analysis & Synthesis
Research & Development
Research & Development
Engineering Technology
Tech Problem Solving
Free Enterprise
Enterprise
Other
Principles of Technology
Interdisciplinary Approaches
Generally offered at grades 10 - 12
Level III
Technology Specialization II
Initial & Intermediate Mastery of Cluster Competencies
Communication Technology
Arch Structures & Design
Comm Electronics Tech
Drafting/Design Tech
Graphic Com Tech
Engineering Graphics Tech
Video Production Tech
Energy & Power Technology
E/Electronics Tech
Alt Energy Systems
Technology Systems Control
Power Mechanics Tech
Transportation Systems
Materials & Processing Technology
Manfacturing Tech
Construction Tech
Engineering Materials Tech
Bio-Technology
Ind Ceramics Tech
Ind Plastics Tech
Ind Metals Tech
Ind Woods Tech
Generally offered at grades 10 - 12
Technology Specialization I
Introduction to Communication Technology
Introduction to Energy & Power Technology
Introduction to Materials & Processing Technology
Exploration of Technology/Industrial Technology I, II, III
Generally offered at grades 8 - 9
Level II
Foundation Building
Introduction to Technology/Industrial Technology
(Prerequisite)
Introduction to Technology /Indus trial Technology I
Introduction to Technology /Indus trial Technology II
Introduction to Technology /Indus trial Technology III
Generally offered at grades 6 - 9
Required of all students
Level I
Awareness Development
Technology Awareness Activities
Elementary School Technology Education
Generally infused into existing K - 6 curriculum

Level III: Initial and Intermediate Cluster Competency Mastery Courses

Technology Specialization I Courses

These courses introduce, either in combined form or in single-system focus, the systems/clusters of technology to students. They are the first of the specialization courses.

• Exploration of Technology/Industrial Technology EX IND TEC C & D 105450 Grades 8-12	An exploration of technology/industrial technology's three clusters (energy & power, materials & processes, communications) that builds depth and breadth. The emphasis is on increased capability with a greater variety of tools, materials, processes, career awareness and reinforcement of basic skills/core competencies.
• Introduction to Communication Technology COMMUN C & D 105435 Grades 9-12	Students develop communication technology capabilities through activities with graphic arts, photography, electronic communication, biological system communication, drafting (CAD) and design, media and information storage and retrieval. Emphasis is placed on developing understanding of the concepts that underlie each application.
• Introduction to Energy & Power Technology ENGY-POWER C & D 105410 Grades 9-12	Students develop energy & power technology capabilities through activities with energy, power, instrumentation, control, electricity/electronics, transportation, conservation, hydraulics and pneumatics and bio-related energy. Emphasis is placed on developing understanding of the scientific principles that underlie each application.
• Introduction to Materials & Processing Technology MATRL-PROC C & D 105420 Grades 9-12	Through manufacturing and construction activities students study the production of products using metal, ceramic, synthetic, and organic (e.g., woods) and biological materials. Experiences also involve management, research, development, marketing and servicing as used by industries providing goods, services and structures.

Technology Specialization II Courses

These courses help students build depth in each of the designated systems/clusters of technology. They offer specializations within a system/cluster as indicated by their name. Examples include but are not limited to, the following:

- Ceramics, woods, metals or plastics
- Digital electronics
- Alternative energy technology
- CAD/CAM
- Robotics, machine control
- Engine technology
- Microprocessor technology
- Engineering graphics

Materials & Processing Cluster Courses

• Manufacturing Technology MFG TECH C & D 105423 Grades 10-12	A study of material processes (separating, combining, forming, conditioning and finishing) in conjunction with the managed sequence of activities used to convert an idea into a useful manufactured product or service.
• Construction Technology CONSTR TEC C & D 105424 Grades 10-12	A study of the designing, planning and constructing of a structure on-site. Emphasis will be on pre-construction, construction and post-construction processes from management through actual construction.
• Engineering Materials Technology ENMAT TEC C & D 105425 Grades 10-12	A study of the materials used for technological applications in production. Includes investigations of the properties and testing (destructive and non-destructive) of metals, wood, ceramics, synthetics and bio-tech materials and their implications for energy, communication, and production.
• Bio-Technology BIOTECH C & D 105401 Grades 10-12	An interdisciplinary study of the materials and processes used in biotechnology. This course involves biological applications in energy & power, communication, and materials & processing areas such as the production of electricity, digesting of pollutants, biological computing, etc.
• Industrial Ceramics Technology IN CER TEC C & D 105421 Grades 10-12	A study of the tools, materials, and industrial processes involved in the manufacturing of products made from nonmetallic resources such as rocks, clay, glass and sand including the industrial ceramic products.
• Industrial Plastics Technology IN PL TECH C & D 195422 Grades 10-12	A study of the operations involved in the manufacture and transformation of synthetics (plastics) into usable products with special emphasis placed on technical information, qualities, specifications and standards. Learning experiences include experimenting, creating, designing, fabricating, forming and evaluating plastic products.
• Industrial Metals Technology IND METALS C & D 105470 Grades 10-12	Study of the operations involved in the transformation of metal into usable products with special emphasis placed on technical information, qualities, specifications and standards. Activities include experimenting, creating, designing, constructing and evaluating metal products in foundry, welding, sheet metal, machine metal areas and automated and/or computerized manufacturing.

• Industrial Woods Technology IND WOODS C & D 105482 Grades 10-12	A study of the woods/cellulose manufacturing industry, the construction of buildings and the production using wood and cellulosic products. Learning experiences include experimenting, designing, constructing, operating and evaluating industrial tools, processes, forest products, related synthetic materials, cabinetmaking, woods machining and finishing.

Energy & Power Cluster Courses

• Electricity/Electronics Technology E/ELTRN C & D 105440 Grades 10-12	A study of the sources, measurements, control and applications of electrical energy in devices such as those used in heating, power, illumination, communications such as the telegraph, telephone, radio, television, radar and computers. Learning activities include experimenting with designing, constructing and testing electrical devices.
• Alternate Energy Systems ALT ENRGY C & D 105413 Grades 10-12	A survey of wind, biomass, solar, geothermal and other nontraditional energy sources, characteristics and applications by means of project and hands-on activity.
• Technology Systems Control TECH SYS C & D 105442 Grades 10-12	Study of the control methods used for technological systems such as industrial equipment and processes. Involves the application of programmable controller semiconductors, photoelectric devices, relays, servomechanisms, hydraulics, pneumatics, mechanics, and electronic heating, together with digital principles and applications. Activities include experiments and practical project work.
• Power Mechanics Technology POWER MECH C & D 105411 Grades 10-12	A study of the development, transmission and utilization of power including the theory, related physical and chemical principles, maintenance and repair of engines and similar power sources.
• Transportation Systems TRANS SYS C & D 105414 Grades 10-12	A study of various transportation systems for materials and people. Trains, cars, boats, airplanes, spacecraft, pipelines and conveyors are sample systems used in the hands-on activities.

Communication Cluster Courses

• Architectural Structures & Design Technology ARCH DGN C & D 105431 Grades 10-12	Communicating, through lines and symbols, information about buildings. Activities involve preliminary sketches, plans, models, elevations, sections, detail drawings, the study of architectural design, history of structures, building ordinances, building materials & processes, and computer-aided drafting.

• Communications Electronics Technology COM ELECTR C & D 105441 Grades 10-12	A detailed foundation of theoretical knowledge, instrumentation and practical application of electronics used in the communications industry. Instruction and hands-on work includes power, supplies, amplifiers, oscillators, transmitters, receivers, electromagnetic radiation and semiconductors.
• Drafting & Design Technology DR-DGNTECH C & D 105430 Grades 10-12	Communication of ideas through drawings, sketches, charts, graphs and maps. Develops skills through freehand, instrument and computer drawing involved in lettering, sketching and dimensioning; geometric construction, ortho-graphic and pictorial drawing; auxiliary, section and working drawings.
• Graphic Communications Technology GR CM-TECH C & D 105492 Grades 10-12	A study of the tools, materials and processes involved in the mass production of communication by means of photography and printing such as intaglio, relief, screen process printing and thermography. Learning activities include using cameras, developing negatives and making contact prints, enlargements, mountings, composition, imposition, presswork and bindery.
• Engineering Graphics Technology ENGR GRAPH C & D 105433 Grades 10-12	A study of the graphic solution to space problems and of the communication of mechanical designs through lines, symbols and drawings. The course involves working drawings, orthographic projection, pictorial views and assembly drawings used in areas such as production, computer-aided drafting, and manufacturing.
• Video Production Technology VIDEO TECH C & D 105432 Grades 10-12	Introduces all stages and aspects of production technology involved with video and related electronic media. The fundamental processes and equipment of video production, including synchronization, signal processing, special effects, and electronic editing are addressed.

Level IV: Analysis and Synthesis Courses

• Research and Development RSCH-DEVEL C & D 105406 Grades 10-12	Targeted on developing technological analysis and synthesis skills, this course allows students to pursue relevant technological problems. Considerable independent work is involved in investigating the theory and practice of significant facets of technology.
• Enterprise ENTERPRISE C & D 105408 Grades 10-12	This course involves student establishment and operation of a manufacturing, construction or service enterprise.

• Engineering Technology Education (I-IV) ENG TECH C & D 105407 Grades 9-12	An introduction to the design and engineering processes and materials currently used in structured problem-solving and design. Students explore futuristic trends and current problems as they experiment, research and develop key facets of technology in any cluster. Typically involves cooperative experiences with engineering firms/ individuals. Serves as a pre-engineering function for advanced students. May be taught sequentially.
• Technology Problem Solving TECH PROB C & D 105409 Grades 9-12	Detailed study of the processes involved in individual and group technological problem solving. Involves design briefs, prototype solutions and the producing of a working original/model.
• Principles of Technology PRIN-TECH C & D 135910 Grades 10-12	Systematic study of the applied physics (optic, mechanics, electronics) underlying most of technology today. Involves experimentation and hands-on activities.
• Interdisciplinary Approaches to Technology INDISCTECH C & D 105402 Grades 9-12	A cross-curricular study of technology, its impacts, and mechanisms. Involves cased studies, experimentation and hands-on activities guided by a team of instructors from various disciplines, such as mathematics, science, social science, language arts, and Industrial Technology/Technology Education.

Other Courses & Assignments

• Other Technology Education/Industrial Technology Courses O IND TECH C & D 105499 Grades 9-12	Included are other organized subject matter content and learning situations in industrial technology/technology education which are not included in any of the other course descriptions.
• Industrial Technology Supervision INTECHSUPV C & D 105497	Involves the coordination and supervision of ITE/TE programs, facilities and faculty. Typically includes planning, control, management and evaluation responsibilities. (Note: requires ITE certification plus a graduate degree in ITE)
• Industrial Technology Departmental Duties INTECHDEPT C & D 105498 Grades 9-12	Involves assigned ITE program duties other than supervision. Usually a special project, e.g., facility or curriculum updating.

Recommended ITE/TE Course Content

This initial list of the key competencies to be developed by each of the five basic courses in the ITE/TE scope & sequence is provided in Chapter VIII's part 4. Each of these courses, has competencies presented in groups suggested by major units of instruction as shown below. Some important content topics within each major unit are also provided for overview purposes. These lists do not imply a sequence for instruction other than what is inherent in the content itself. **Instructors may well wish to reorganize the competencies into different units if it is appropriate to their course goals.** Since the implementation of these courses will vary in length, content may be added/substituted as long as the intent of the course, within the scope & sequence, is maintained.

Introduction to Technology

Suggested Content Outline

1. Overview of Technology
   - What Is Technology?
   - How Is Technology Organized?
   - What Are the Effects of Technology?
2. Working With Technology
   - Fundamentals of Measurement
   - Information Processing
   - Problem Solving Techniques--Technological Method
   - Group Organization and Management
   - Safety
   - Understanding Work/Yourself
   - Exploring Occupations
   - Computers
3. Energy and Power Technology
   - Overview of Energy and Power Technology
   - Nature of Energy
   - Conversion of Selected Energy Forms
   - Conservation of Energy Resources
   - Choice of Optimum Energy Source
   - Systems of Power Transmission
   - Transportation
   - Selected Emerging Areas
4. Communication Technology
   - Overview of Communication Technology
   - Elements of the Communication Process
   - Optical (Visual) Communication Systems
   - Acoustical (Audio) Communication Systems
   - Combined Optical/Acoustical (Audio-Visual) Systems
   - Other Communication Systems
   - Selected Emerging Areas: Communication Technology
5. Materials and Processing Technology
   - Overview of Materials & Processing Technology
   - Industrial Materials
   - Raw Materials Preparation Processes
   - Standard Stock Production Processes
   - Manufacturing Production Processes
   - Manufacturing Technology
   - Construction Technology
   - Selected Emerging Areas: Materials & Processing Technology

Introduction to Technology

Suggested Major Units of Instruction

1. **Overview of Technology**
2. **Working With Technology**
3. **Energy and Power Technology**
4. **Communication Technology**
5. **Materials & Processing Technology**

Exploration of Technology/Industrial Technology

Suggested Content Outline

1. Overview of Technology
    - The Nature of Technology
    - The Organization of Technology
    - The Effects of Technology
2. Working With Technology
    - Fundamentals of Measurement
    - Information Processing
    - Problem Solving Techniques/Technological Method
    - Safety
    - Understanding Work/Yourself
    - Occupational Resources
    - Computers
3. Energy and Power Technology
    - Overview of Energy and Power
    - Nature of Energy
    - Conversion of Selected Energy Forms
    - Conservation of Energy Resources
    - Choice of Optimum Energy Source
    - Systems of Power Transmission
    - Transportation
    - Selected Emerging Areas
        - Energy Conversion Systems
4. Communication Technology
    - Overview of Communication Technology
    - Elements of the Communication Process
    - Optical (Visual) Communication Systems
    - Acoustical (Audio) Communication Systems
    - Combined Optical/Acoustical (Audio-Visual) Systems
    - Other Communication Systems
    - Selected Emerging Areas: Communication Technology
5. Materials and Processing Technology
    - Overview of Materials and Processing Technology
    - Industrial Materials
    - Raw Materials Preparation Processes
    - Standard Stock Production Processes
    - Manufacturing Production Processes
    - Manufacturing Technology
    - Construction Technology
    - Selected Emerging Areas: Materials & Processing Technology
6. Human Resources Technology
    - Group Organization and Management
    - Enterprise Simulation
    - Student Organizations

Explorations of Technology

Suggested Major Units of Instruction

1. Overview of Technology
2. Working With Technology
3. Energy and Power Technology
4. Communication Technology
5. Materials & Processing Technology
6. Human Resources Technology

Introduction to Communication Technology

Suggested Content Outline

1. Overview of Communication Technology
   - Definitions
   - Communication System Models
   - Relationship of Other Curricular Areas to Communication Technology
   - Timeline of Communication
   - Special Safety Concerns
   - Careers in the Communication Industries
   - Regulation of Communication
   - Impacts of Communication Technology
2. Signs, Symbols and Technical Drawing
   - Pictographs
   - Alphanumeric Symbols/Messages
   - Technical Drawing Symbols/Messages
   - Careers
3. Printing Systems for Communication
   - Image Transfer Subsystems
   - Production Sequence
   - Equipment and Materials
   - Basic Principles
   - Computer Generated Graphic Reproduction
   - Applications
     - Impact
   - Careers
4. Photographic Systems of Communication
   - Photographic Sub-Systems
   - Production Sequence
   - Equipment and Materials
   - Applications & Impact
5. Telecommunication-Hardwired Systems
   - Applications
   - Impact
   - Careers
6. Telecommunication-Electromagnetic Systems
   - Electromagnetic Audio
   - Transmission/Reception Systems
   - Applications
   - Impact
   - Careers
7. Storage and Retrieval Systems
   - Historical Systems
   - Modern Systems
   - Encoding and Decoding Used
   - Equipment and Materials
8. Telecommunication-Audio/Visual Systems
   - Television
   - Audio-Visual Projectors

Intro. to Communication Technology

Suggested Major Units of Instruction

1. **Overview of Communication**
2. **Signs, Symbols & Technical Drwg**
3. **Printing Systems for Communication**
4. **Photographic Systems of Communication**
5. **Telecommunication-Hardwired Systems**
6. **Telecommunication-Electromagnetic Systems**
7. **Storage and Retrieval Systems**
8. **Telecommunication-Audio/Visual Systems**
9. **Careers in Communication Technology**
10. **Technological Procedures in Communication**
11. **Leadership in the Communication Field**
12. **Future Trends in Communication Technology**

- Videophones
- Applications
- Impacts
- Careers

9. Careers in Communication Technology
    - Personal Assessment
    - Career Exploration
    - Employability Skills
    - Occupations and Skill Levels
    - Careers and Technological Trends
    - Education and Training
    - Entrepreneurial Endeavors
10. Technological Procedures in Communication Technology
    - Context of Communication Technology
    - Terminology
    - Applications of Technical Communication Systems
    - Regulation and Standardization
    - Problem Solving in Technology (The Technological Method)
    - Impact of Communication Technology
11. Leadership in the Communication Fields
    - Characteristics of Effective Leadership
    - Individual Leadership
    - Group Leadership
    - Student Organization Activities
12. Future Trends in Communication Technology
    - Transmission Systems
    - Display Technology
    - Printers
    - Storage
    - Microprocessors - "Supercomputers"
    - Software
    - Publishing
    - Impacts

Energy & Power Technology

Suggested Content Outline

1. Energy & Power Technology Overview
    - Energy & Power Systems
    - Components of Energy & Power Technology Systems
    - Interface to Communication Technology
    - Interface to Materials & Processing Technology
    - Energy & Power Technology Impacts
    - Safety
    - Scientific Foundations of Energy & Power Technology
2. Technological Procedures
    - Experimentation

- Information Accessing/Retrieval/Storage
- Information Processing
- Information Reporting
- Innovation
- Problem-solving Processes
- Systems Analysis & Synthesis
- Technology Assessment

3. Energy Fundamentals: Forms & Conversions
   - Basic Definitions and Concepts
   - Energy Measurement
   - Energy Sources
   - Energy Conversions
   - Renewable/Inexhaustible--Non-renewable/Exhaustible
   - Alternative Energy Systems
4. Power Technology Fundamentals
   - Definitions
   - Types of Power Transmission
   - Measurement
   - Power Conversion
5. Instrumentation & Control Fundamentals
   - Systems Configurations
   - Types of Instrumentation & Control Systems & Components
   - Ergonomics
6. Energy & Power Technology Applications
   - Applications in Transportation
   - Applications in Material Processing
   - Applications in Communications
   - Environmental Control Applications
   - Other Applications Areas
   - Power Distribution
   - Ethics
   - Economics
7. Electricity/Electronics Technology Applications
   - Definitions
   - Electricity/Electronics Fundamentals
   - Electricity/Electronics Components
   - Electricity/Electronics Measurement
   - Electricity/Electronics Safety
8. Careers in Energy & Power Technology
   - Personal Assessment
   - Career and Technological Trends
   - Employability Skills
   - Career Directions and Opportunities
9. Leadership Roles in Technology
   - Individual Leadership
   - Group Leadership
   - Student Organization Activities

Intro. to Energy & Power Technology

Suggested Major Units of Instruction

1. **Energy & Power Technology Overview**
2. **Technological Procedures**
3. **Energy Fundamentals: Forms & Conversions**
4. **Power Technology Fundamentals**
5. **Control & Instrumentation Fundamentals**
6. **Energy & Power Technology Applications**
7. **Electricity/Electronics Technology Applications**
8. **Careers in Energy & Power Technology**
9. **Leadership Roles in Technology**

Materials & Processing Technology

Suggested Content Outline

1. Materials & Processing Technology Overview
    - Components of Materials & Processing Systems
    - Interface to Communication Technology
    - Interface to Energy & Power Technology
    - Types of Materials & Processing Production
    - Scientific Foundations Materials & Processing Tech.
    - Materials & Processing Technology Impacts
    - Safety
    - Management in Materials & Processing Technology
2. Technological Procedures
    - Information Accessing/Retrieval/Storage
    - Information Processing
    - Information Reporting
    - Problem-solving Processes
    - Systems Analysis & Designs
    - Technology Assessment Standards Development
    - Information Applications
    - Impact of Information Technology
3. Materials Technology Fundamentals
    - Basic Classification of Materials
    - Materials Specifications
    - Materials Properties
    - Materials Testing
    - Extraction/Harvest
    - Materials Processing Processes
    - Economic Characteristics of Materials
    - Safety
    - Equipment
4. Construction Technology Fundamentals
    - Types of Structures
    - Types of Construction Procedures
    - Construction Planning
    - Construction Methods and Processes
    - Materials and Supplies
    - Tools and Equipment
    - Estimating and Cost Analysis
    - Utilities
    - Site Preparation
    - Safety and Site Security
    - Management, Quality and Labor Relations
    - Legal Documentation & Requirements
    - Sales & Real Estate
    - Servicing & Maintenance of Structures
5. Manufacturing Technology Fundamentals
    - Manufacturing Systems
    - Materials and Supplies
    - Tools, Machines, & Equipment
    - Processing
    - Research and Development
    - Management
    - Financing/Enterprise

Intro. to Materials & Processing

Suggested Major Units of Instruction

1. **Materials & Processing Technology Overview**
2. **Technological Procedures**
3. **Materials Technology Fund'ls**
4. **Construction Technology Fundamentals**
5. **Manufacturing Technology Fundamentals**
6. **Materials & Processing Technology Applications**
7. **Careers in Materials & Processing Technology**
8. **Leadership Roles in Technology**

- Marketing
- Safety in Manufacturing
- Labor Relations
- Post-processing/servicing
- Ecology
- Future Trends

6. Materials & Processing Technology Applications
   - Industrial Technology as Context
   - Terminology
   - Example Applications
   - Quality Control
   - Problem Solving in Technology
   - Materials and Processing Impact
   - Emerging Technologies & Materials
7. Careers in Materials & Processing Technology
   - Career Explorations
   - Personal Assessment
   - Employability Skills
   - Occupations Identification Classifications
   - Career and Technological Trends
   - Education and Training
   - Entrepreneurial Activity & Opportunity
   - Career Forecasting
8. Leadership Roles in Technology
   - Characteristics of Positive Leadership
   - Individual Leadership
   - Group Leadership
   - Student Organization Activities

4. Revising/Updating Existing Programs

Updating: Why and What?

Most readers will already be operating an Industrial Technology/Technology Education/industrial arts program. Many will be doing so in aging facilities. Some even with aging curricula. However, the profession's thrust is clearly forward.

Why update? Clearly our professional responsibility to our students and to society requires that they receive the best program possible—one that is responsive to the technological demands of our world. A program that introduces students to modern technology and its processes. Updating enables us to meet this responsibility. Additionally it brings its own rewards that often include:

- A boost in morale among students, parents, faculty and administration.
- Increased relevance. This causes people to believe in the importance of our program's contribution to youth.
- Increased enrollments.
- Better goal achievement and evaluations for you and the school.

But what does one update? Look around. That's right. The visible is a great place to start. If people see a significant change in the laboratory they are more likely to believe a programmatic change has also been made. Of course, facilities are but the vehicle through which we help youth learn about industry and technology, but they play an important role in securing support because they show tangible evidence of your commitment.

The program of studies must also be updated to reflect changes in technology. Program consists primarily of the following:

- Curriculum (content, activities and sequence)
- Facility (building, laboratory, equipment)
- School policies (course designation, advisement)

Teachers need to work to insure a consistency among these three main components of a program: curriculum, facility and policies. The recommended sequence is shown above. First one must clarify the purposes and form of the curriculum, its content, activities and sequences. Once the curriculum is established, one can analyze what is needed in terms of facility and equipment. Finally, a review of school policy needs to be conducted to insure that policies support the program? For example:

- Is ITE/TE recommended for all students?
- Are ITE/TE courses scheduled at times to permit all students to participate?
- Are ITE/TE instructors provided reasonable time for preparation and summer/fall shut down/start up?
- Is the student association supported?

Development of the scope and sequence is another excellent way of updating the curriculum. This involves the establishment of course titles, descriptions and objectives and which provides a logical opportunity to update the program. At this time, interaction with math, science, English and vocational colleagues to identify appropriate ITE/TE articulation mechanisms with general and vocational education courses is also recommended.

What does updating involve? First, it requires a **willingness** to do things in a way different than before. Often it is difficult to see how this might be done. One of the best ways over this is to get outside opinions and perspectives. Start with good teachers and students in your own school, invite the state supervisor, a teacher educator, or a representative of industry. Be careful, however, that advisors understand the overall purposes of ITE/TE! The key steps to the updating process are:

- Evaluate the program carefully. The Missouri Industrial Technology Standards (available from Missouri's ITE Supervisor) are recommended.
- Get outside opinion as to what might be improved and how to do it.
- Look at as many good examples of programming as you can.
- Carefully list the barriers for updating and how they might be overcome.
- Develop a plan identifying what needs to be updated and why.
- Tie your plan into major thrusts of the schools, e.g., VIMS, core competencies, reinforcement of basic skills or the like.
- Work out a proposal to systematically implement the desired changes, in priority order, over a reasonable period of time, e.g., five years.
- Market your plan to the key decision-makers in your district/building. Be sure to incorporate advantages for each of the key audiences.
- Get formal administrative approval for your plan.

Change Strategies

It is important that ITE/TE teachers have some understanding of how the change process works. Research shows that change is something that must be carefully planned, facilitated, and nurtured if positive results are to be achieved. The wisdom in the old adage, "Things take time," is quite true. It takes time to plan for change. Support and confidence must be engendered. Ideas take time to mature and gel. Colleagues, administrators, students, parents, and other concerned groups must be given time to adjust to and eventually support the changes which are occurring.

Change strategies can be divided into two categories; those focusing on ***internal*** (within the school) and ***external*** considerations (outside of the school).

Internal Considerations

- All staff need to become aware of (and supportive of) the need for change. It is impossible to separate facility change from curriculum change. ***They must go together***.
- It is important that the entire ITE/TE faculty feel some ownership of the change, or it won't work. Open communication and opportunity for input must be insured during every stage of the process.
- Remember, times of change (even when welcomed) are both exciting and threatening. It is critical that communication channels be kept open to allow everyone involved an opportunity to express themselves and adjust to the impending changes.

- It is very important that change be facilitated. Often it must happen slowly and change agents will often have to be patient. The age-old notion—that the best way to facilitate change—is to plant seeds and then let others think it was their idea, is still wise counsel.
- A person should be designated to interact with the administration on behalf of the faculty.

External Considerations

- It is important to present a unified and well thought-out plan to the administration. Administrators will not respond well to uncoordinated and piecemeal requests for single equipment items or facility changes. They will want solid evidence that the changes have been carefully considered and that the homework has been done.
- When approaching the administration with proposed change, the place *not* to begin is with facilities. The best approach is to begin with your curriculum. Not only is this good politics but also solid educational planning. Only after the faculty have carefully reviewed the program's total educational plan (including departmental philosophy, goals, and future directions), is the time right for looking at the facility changes that will be required to deliver the curriculum. Administrators will appreciate the work. The faculty can grow as a result.

The age-old notion—that the best way to facilitate change—is to plant seeds and then let others think it was their idea, is still wise counsel.

- School facility visitations should be considered. The departmental "point person" could ask the superintendent or principal to join in a trip to one of Missouri's (or the nation's) top labs. This will not only provide an opportunity to see the facility, but will also provide opportunity for in-depth discussion and interpretation of the proposed changes.
- Keep a steady stream of good information moving into your administrator's hands. This information can be in the form of an article in a trade journal, something out of a popular magazine, a newspaper clipping, etc., which emphasizes the new trends in industry and in industrial technology/technology education.
- It is extremely important that you carry yourself in a manner that communicates confidence, competence, experience, enthusiasm, and good judgment. It goes without saying that ITE/TE is in the midst of an image change. Administrators are going to develop a new image of "shop teachers."
- It is important to develop a thorough facility renovation proposal that emphasizes solid educational planning. Administrators tend to respond to change if it is clearly presented, well written, and educationally sound.
- Other factors which will help promote change with administrators include:
    - Show involvement in professional organizations at both the national and state levels. It shows that you are alert to the changes that are occurring in the field.

- Invite the administrative personnel to tour your facility. This can be an opportunity to begin to "sell" the change possibilities in a positive and informal manner.
- Conduct open houses where at least part of what is shown (or demonstrated) is designed to feature new directions in technology.
- Be alert to the many promotional opportunities that can be done in subtile ways. Many times, administrative personnel will need to "warm up" to the vision and possibilities behind the proposed changes.
- Watch for opportunities to subtly promote your program. A positive conversation over lunch or coffee can sometimes have as much impact as a brochure or video.
- Convey the sense that you believe in your program and its potential. ***Show excitement!***
- Remember, many administrators are generalists. They depend on you for the details of your field. They respond positively to changes that present the school in a positive light.

5. Starting a New ITE/TE Program

In some cases, a school system will be establishing a new ITE/TE program. Typically, this occurs when:

- A new school is being built
- An existing program is being extended to a new setting, e.g.,
  - A junior high school program will be extended to the high school
  - A senior high school program will be extended to the junior high school
- A program, temporarily closed for the lack of a teacher, reopens with a new hire.

Generally, each of these situations presents a good time to rethink the overall program design. This involves:

1. Establishment of program goals (See Part 7 of this chapter).
2. Development of the program's scope and sequence (See Part 2 of this chapter).
3. Documentation of each course in the program (See Part 6 of this chapter).
4. Design/adaptation of the laboratory facility in which the program will be conducted (See Chapter III).
5. Review of school system policy (See Chapter VII, VIII, & IX).

These procedures have been described in other sections of this guide. Refer to these other pages for guidance on these steps. The overview of this process, and a time estimate for each step, is shown in Figure II-4 and details of the curriculum documentation process are provided in Figure II-5.

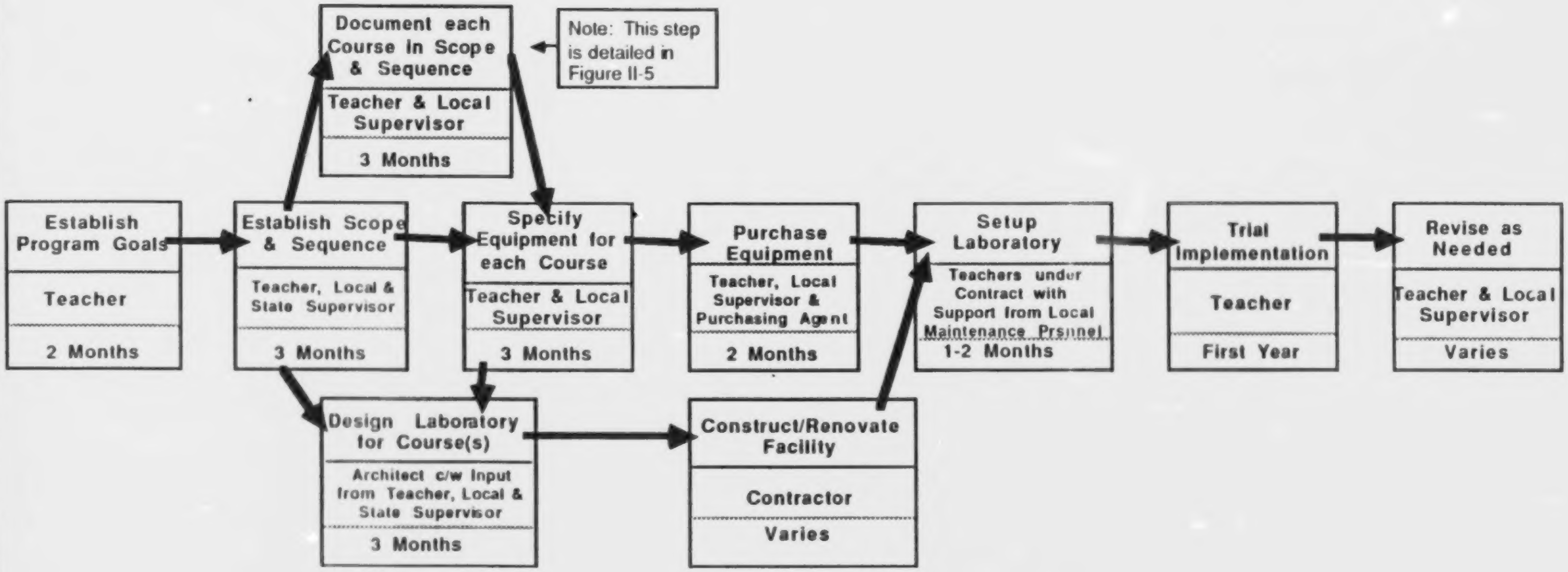

Document each Course in Scope & Sequence
Teacher & Local Supervisor
3 Months
Note: This step is detailed in Figure II-5
Establish Program Goals
Teacher
2 Months
Establish Scope & Sequence
Teacher, Local & State Supervisor
3 Months
Specify Equipment for each Course
Teacher & Local Supervisor
3 Months
Purchase Equipment
Teacher, Local Supervisor & Purchasing Agent
2 Months
Setup Laboratory
Teachers under Contract with Support from Local Maintenance Prsnnel
1-2 Months
Trial Implementation
Teacher
First Year
Revise as Needed
Teacher & Local Supervisor
Varies
Design Laboratory for Course(s)
Architect c/w Input from Teacher, Local & State Supervisor
3 Months
Construct/Renovate Facility
Contractor
Varies

Figure II-4 Steps in Implementing New Programs

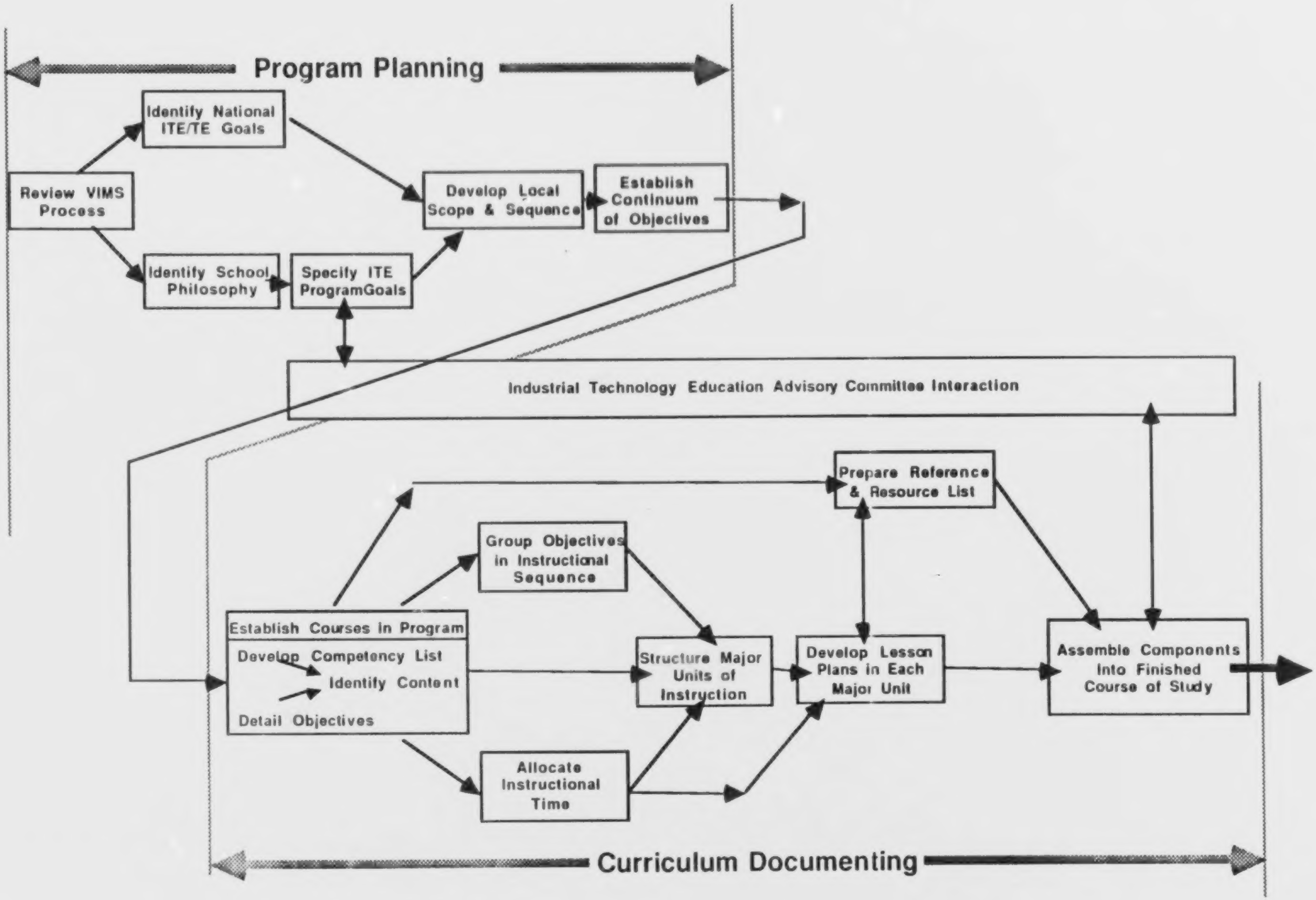

Program Planning
Identify National ITE/TE Goals
Review VIMS Process
Develop Local Scope & Sequence
Establish Continuum of Objectives
Identify School Philosophy
Specify ITE ProgramGoals
Industrial Technology Education Advisory Committee Interaction
Prepare Reference & Resource List
Group Objectives in Instructional Sequence
Establish Courses in Program
Develop Competency List
Identify Content
Detail Objectives
Structure Major Units of Instruction
Develop Lesson Plans in Each Major Unit
Assemble Components Into Finished Course of Study
Allocate Instructional Time
Curriculum Documenting

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Figure II-5 Steps in Documenting a Curriculum

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6. *Program Planning Quality Control*

ITE/TE instructors who update their programs or who plan new ones often want to know if their plans align with the generally accepted standards of the profession. One efficient way of double-checking one's work is to use the MO ITE Standards as a check list. Figures II-6 and II-7 present the topics most appropriate to program planning.

Figure II-6

MOITE Standards, Topic 2: Instructional Program

The instructional program in technology education and/or industrial technology will provide youth with knowledge, skills, and attitudes to intelligently create and control their environment. Such a comprehensive program will need to reflect our rapidly changing technological society. The statements contained within this standard topic concern the instructional program. This program, which reflects the stated philosophy, provides a wide variety of organized experiences for all students. These experiences assist learners in reaching predetermined goals.

Fill in marks to indicate assessment: **∇ not met,** 0 **met,** Δ **exceeded**

1. Emphasis is placed upon assisting students in developing insight and understanding of our industrial and/or technological society. .... ∇ 0 Δ
2. Emphasis is placed upon improving student ability to make informed and meaningful occupational/career choices. .... ∇ 0 Δ
3. Emphasis is placed upon preparing students for entry into specialized technical training and/or advanced professional programs in technology. .... ∇ 0 Δ
4. Emphasis is placed upon preparing students for entry into advanced trade and industrial, technical, or other advanced education programs. .... ∇ 0 Δ
5. Emphasis is placed upon preparing students for lifelong learning in a technological society. .... ∇ 0 Δ
6. Emphasis is placed upon developing student talents, creative abilities, positive self-concepts, and individual potentials related to technology-industrial-technical areas. .... ∇ 0 Δ
7. Emphasis is placed upon developing student abilities in the safe and proper use of tools, materials, machines, and processes. .... ∇ 0 Δ
8. Emphasis is placed upon applying tools, materials, machines and processes, and technical concepts safely and efficiently. .... ∇ 0 Δ
9. Emphasis is placed upon developing student problem- solving and decision-making abilities involving human and material resources, processes and technological systems. .... ∇ 0 Δ
10. Emphasis is placed upon reinforcing the basic skills and interrelating the content of technology/industrial technology with other school subjects. .... ∇ 0 Δ
11. Emphasis is placed upon developing leadership ability, encouraging and promoting responsibility, and developing positive social interaction through TSA or local program student club. .... ∇ 0 Δ

Figure II-6

MOITE Standards, Topic 2: Instructional Program, continued

Fill in marks to indicate assessment: ∇ **not met,** 0 **met,** Δ **exceeded**

12. Program goals are written and are on file. (Note: if the answer is "no", then standards 30-34 are also marked "no".) .... ∇ 0 Δ
13. Program goals are consistent with local, state, and national standards and emerging developments in technology education and/or industrial technology .... ∇ 0 Δ
14. Program goals are developed with input from teachers, administrators, students, representatives from business and industry, and other consultants, as necessary .... ∇ 0 Δ
15. Program goals are written and are on file. .... ∇ 0 Δ
16. Program goals are utilized by teachers and administrators for planning, implementing, and evaluating courses. .... ∇ 0 Δ
17. Program goals are reviewed annually and revised when necessary. .... ∇ 0 Δ
18. Course objectives, written in measurable terms, are presented to students and are kept on file. (Note: if the answer is "no", then standards 36 & 37 are also marked "no".) .... ∇ 0 Δ
19. Course objectives are utilized by teachers and administrators for planning, implementing, and evaluating course content and instructional methods. .... ∇ 0 Δ
20. Course objectives are utilized as a basis for developing the industrial technology education component of the Individualized Education Program (IEP). .... ∇ 0 Δ
21. Course content is developed from course objectives and utilizes approved curriculum guides, courses of study, and other professional resources. .... ∇ 0 Δ
22. Course content is offered in the broad categories of communication, construction, manufacturing, and transportation. .... ∇ 0 Δ
23. Course content is selected to provide for all students. .... ∇ 0 Δ
24. Course content includes the development of personal and leadership skills through TSA or local program student club. .... ∇ 0 Δ
25. Courses in the industrial technology/technology education program are sequential, beginning with broad orientation and exploration of subject matter areas, followed by specialized experiences .... ∇ 0 Δ
26. Course content represents the state of the art in industry and/or technology. .... ∇ 0 Δ
27. Course content is organized into course outlines, unit plans, and lesson plans which are on file. .... ∇ 0 Δ
28. An accurate description for each course is available to all students prior to enrollment .... ∇ 0 Δ
29. Course content is reviewed annually and revised when necessary. .... ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): — — —

Figure II-7

MOITE Standards, Topic 3: Student Populations Served

All people live and work in our society, which is impacted by technological growth. It is paramount that all students, regardless of future goals, develop a comprehension of industry and technology. The statements contained within this standard topic concern the student populations served. The technology education program and/or industrial technology program may serve all persons, preschool through adult. Accommodations in the program are made for students with special needs.

Fill in marks to indicate assessment: ∇ **not met,** 0 **met,** Δ **exceeded**

1. Industrial technology/technology education is offered for a minimum of 18 weeks, 225 minutes per week at each grade level of the junior high/middle school and/or in each course at the senior high/high school. ∇ 0 Δ
2. School scheduling procedures allow equal opportunities for all students to enroll in technology education courses of their choice. ∇ 0 Δ
3. Students are encouraged to enroll in courses from more that one content category during their total industrial technology experience. ∇ 0 Δ
4. All students are provided a variety of effective and meaningful learning experiences commensurate with technology education/industrial technology program goals and course objectives. ∇ 0 Δ
5. Students who are academically and/or economically disadvantaged are provided special services and assistance, as required, to enable them to succeed in the industrial technology/technology education. ∇ 0 Δ
6. Students who have physical, mental, and/or emotional impairments are provided special services and assistance, as required, to enable them to succeed in the industrial technology/technology education program. ∇ 0 Δ
7. Students identified as handicapped and requiring additional or modified educational services or materials are enrolled only after the Individualized Education Program (IEP) has been prepared. ∇ 0 Δ
8. Students identified as gifted and/or talented are provided learning activities consistent with their abilities. ∇ 0 Δ
9. Industrial technology/technology education is provided for students, regardless of their cultural differences. ∇ 0 Δ
10. Technology education/industrial technology activities are provided for all students appropriate to their maturity and/or educational level. ∇ 0 Δ
11. Females, as well as males, are encouraged to enroll in technology education/industrial technology courses, with activities provided on a sex-fair basis. ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): — — —

7. *Documenting the Curriculum*

ITE/TE teachers will often face a need to describe their curriculum on paper. This curriculum development results in documentation of the curriculum. Typically many different formats are used—depending on the purposes each document is to serve—i.e., who will be using it and for what purposes.

Curriculum Components

The following pages will highlight the essential features and quality guidelines for the various elements that document the curricula. Figures II-4 & II-5 provide a flowcharts showing one approach to curriculum documentation. The details of each curriculum component are provided as follows:

● Instructional Management System	Page II-29
● Continuum of Objectives	Page II-31
● Course of Study	Page II-32
● Major Units of Instruction	Page II-36
● Technology Activity Modules (TAMS)	Page II-41
● Lesson Plans	Page II-44

Instructional Management Systems

In Missouri, there is serious commitment to instructional management systems (IMS) that encourage quality of programming. As a result, the Missouri Department of Elementary and Secondary Education has evolved a systematic IMS and the vocational community within Missouri's educational system has evolved a VIMS that can be a useful guide to curriculum development and quality control. Both systems are based on the same principles and these are combined into a generalized system which is pictured in Figure II-8.

IMS Step 1: The locally developed scope and sequence should state the course goals for each course in the ITE/TE program sequence and they should be consistent with ITE/TE's overall goals as provided in Chapter I.

IMS Step 2: The second step is to establish a list of course competencies which are developed by each course in the ITE/TE program. Chapter X provides competency lists for the ITE/TE program's five core courses.

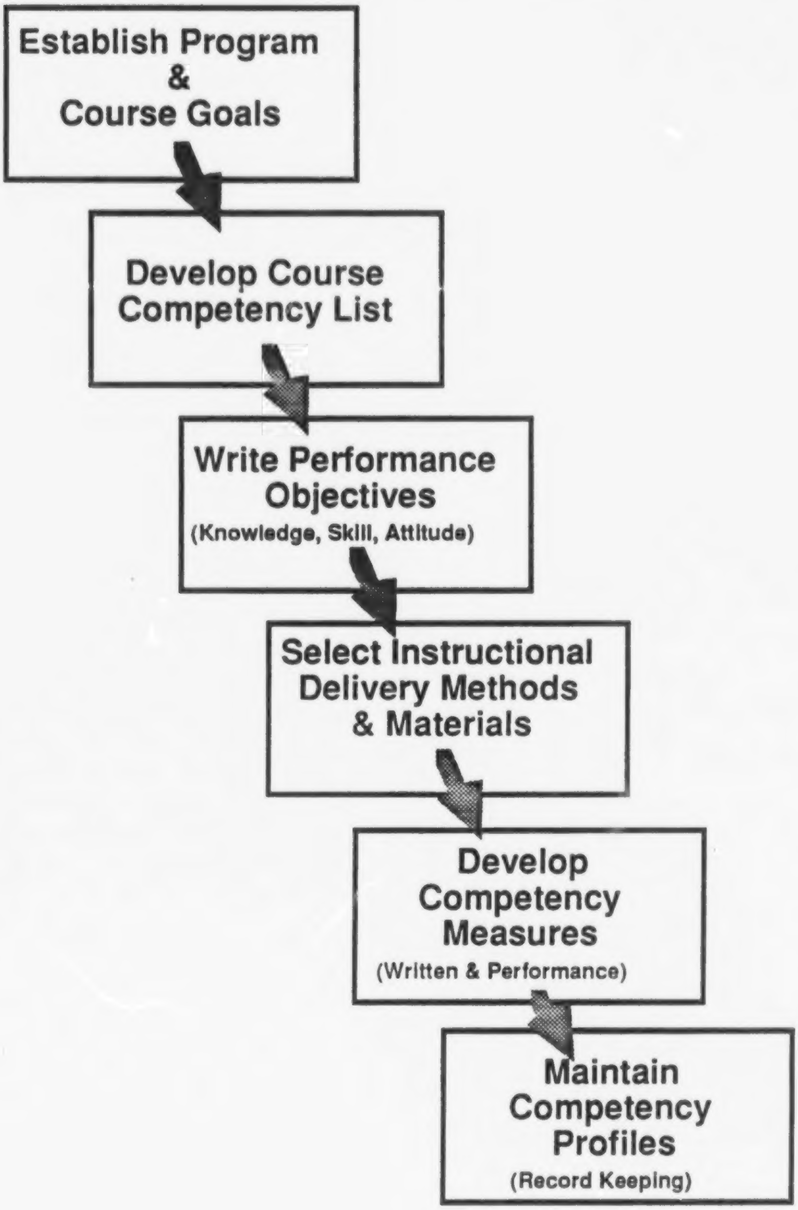
IMS Step 3: Performance objectives are the third step in the process. Here instructors translate the competencies to be developed by each course into clear statements of educational outcomes. In ITE/TE, these objectives usually involve performance in all three domains: cognitive (knowledge), affective (attitudes) and psychomotor (skills).

Typically, instructors will write performance objectives to detail specific lessons and/or activities. These objectives are written to include specific treatment of:

- Observable behavior/performance
- Conditions of instruction/testing
- Criteria for judging success

Figure II-8

Component Parts of an Instructional Management System[1]


Establish Program & Course Goals
Develop Course Competency List
Write Performance Objectives (Knowledge, Skill, Attitude)
Select Instructional Delivery Methods & Materials
Develop Competency Measures (Written & Performance)
Maintain Competency Profiles (Record Keeping)

---

[1] Adapted from Missouri's VIMS and consistent with Missouri's IMS.

IMS Step 4: The IMS process' fourth step involves the development of instructional delivery methods and the materials needed to implement them. Chapter's II and VI detail these procedures and materials. Although many different types exist, the most frequently used materials include:

- Courses of Study
- Major Unit Plans
- Lesson Plans
- Job Sheets/Assignment Sheets
- Information Sheets
- Self-Instructional Modules

IMS Step 5: The fifth step involves the development of competency measures for each lesson, major unit, or competency. Note that these can take many forms. Some useful ones are:

- Paper and pencil tests of all kinds
- Performance tests
- Observations and checklists
- Self-tests

IMS Step 6: Finally, IMS requires the careful recording of each students' progress towards mastery of the competency assigned to each course. This usually involves recording of "mastery," "mastery with supervision," or "not-attempted" beside each competency as the student demonstrates his/her capabilities.

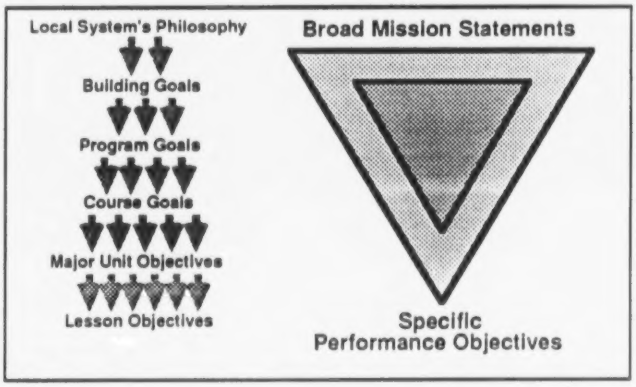
A locally developed IMS offers an excellent way to clarify and raise expectations for student achievement. The IMS concept is based on the conclusion that *all students* can meet reasonable academic and skill-performance standards on important educational objectives.

Continuum of Objectives

Quality Education has a continuity to it. This begins with a statement of the school system's philosophy of education. It is important that this statement provides an "anchor" for ITE/TE. Usually this is by means of a statement that speaks to the importance of occupational (vocational), career, avocational and technological goals of schooling for the system. The local system's philosophy starts the entire chain (continuum) as shown in Figure II-9.

Figure II-9

The Continuum of Objectives



Now, with respect to any single course, it becomes obvious that any course accomplishes what its components, i.e., its major units of instruction accomplish. Therefore, it is absolutely imperative that the major unit goals within any course result in the achievement of **all** of the course's goals—nothing less or more!

Using the same logic then, it becomes clear that each major unit's goals are accomplished through its lessons. Therefore, the cumulative effect of all the lessons in any major unit must be the achievement of **all** of the major unit's goals—nothing less or more! When an instructor's system of program, course, unit and lesson documentation demonstrates such internal consistency, he/she may consider themselves to have reached a most important quality milestone.

Course of Study

Perhaps the single most important product of course and program documentation is the course of study. Why? Because it is the package that assembles all of the components of curriculum documentation into one coherent whole. Ideally the course of study for each course should be neatly organized in a three-ring loose-leaf binder so that access, further development and revisions are facilitated.

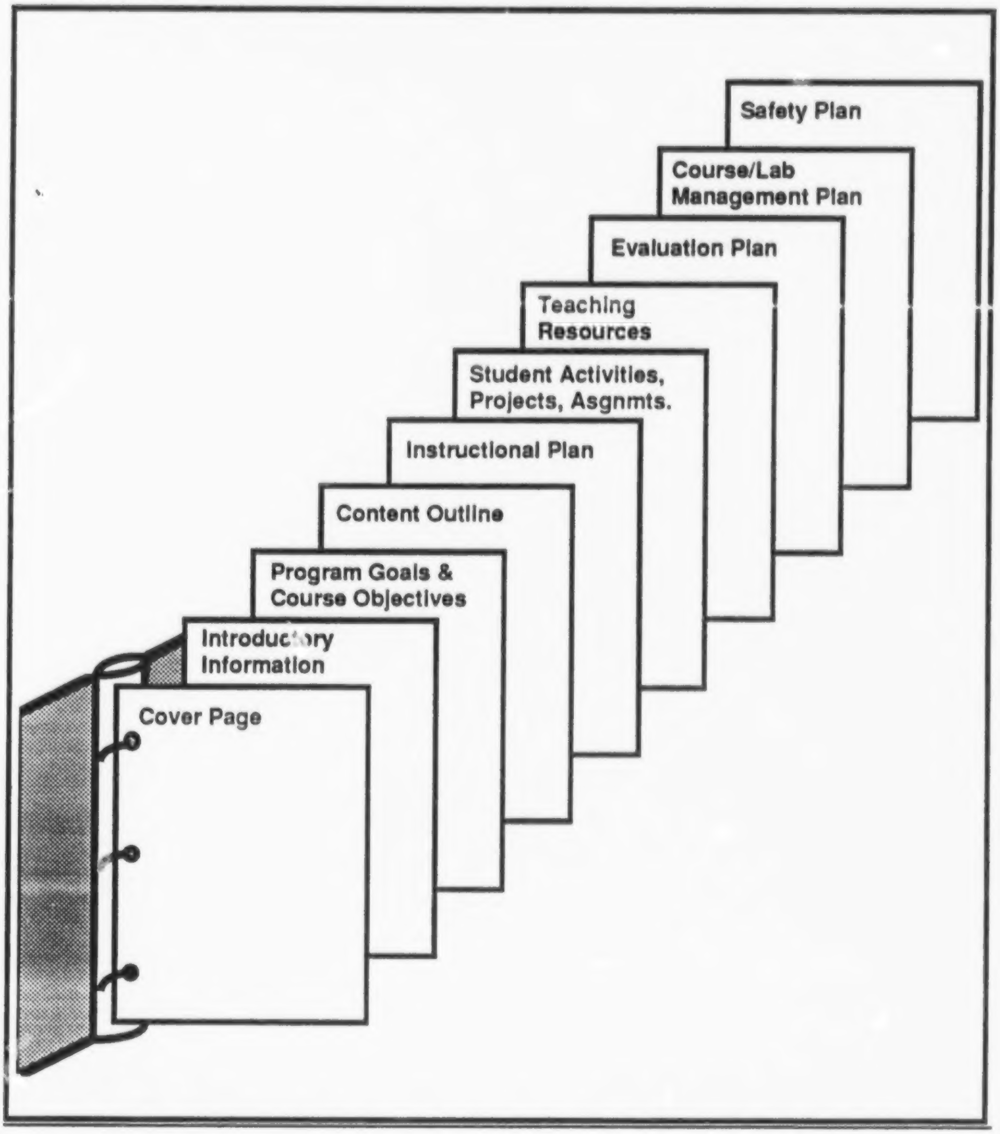
Courses of study can contain many different items—often because of local requirements. However, Figure II-10 shows a reasonable consensus of the most important **categories** of items and their logical sequence.

The items included in courses of study, and the recommended information contained in each, are described in the following paragraphs. Of course each section may (and should) be tailored to meet local requirements—however, sections should not be diluted, i.e., contain less than what is recommended.

1. Cover Page
   a. A clear descriptive title and local system course number (if used) is provided. Also show the appropriate C&D report course number.
   b. Department, school, district, state and person preparing the course of study.
   c. Date the course of study was prepared/revised.
2. Introductory Information
   a. Foreword
      - Statements necessary to communicate intent of course
      - Acknowledgements (optional)
   b. Introduction & Overview
      - Nature, scope and organization of the course
      - Length of the course
      - Grade level and student for which the course is intended
      - Time allotment
      - Limits of the course
      - Credit to be earned
      - Prerequisites, if any
   c. Table of Contents
3. Program Goals and Course Objectives (in context)
   a. National Goals of ITE/TE (optional)
   b. State Goals of Education and ITE/TE

Figure II-10

Components of a Course of Study


Safety Plan
Course/Lab Management Plan
Evaluation Plan
Teaching Resources
Student Activities, Projects, Asgnmts.
Instructional Plan
Content Outline
Program Goals & Course Objectives
Introductory Information
Cover Page

   c. Local System Philosophy
   d. School Philosophy of Education
   e. Local ITE/TE Program Goals
   f. Course Objectives
4. Course Content Outline
   a. List of competencies to be developed by each student
   b. A narrative description of the content to be covered by the course
5. Instructional Plan
   a. Major Units of Instruction
   b. Time allotment for each major unit and each lesson plan within it.
   c. For each major unit, list
      - Title
      - Major Unit Objective(s) (Scope of Unit Statement)
      - Lesson Plan/Module Titles
      - Pre/Post Tests
6. Student Projects, Assignments and Activities (Major)
   a. Assignment sheet(s)
   b. Job sheet(s)
   c. Experiment sheet(s)
   d. Other related document(s)
7. Teaching Resources: Texts, Reference, Aids and Devices
   a. List major visual and auditory aids (films, cassettes, bulletins, etc.) to be used. Note, these can be listed in individual lesson plans, in separate lists for each major unit or in one overall list for each course
   b. List and use of models, charts, graphs, maps, etc.
8. Evaluation Plan
   a. Progress charts for recording student achievement (competency lists)
   b. Tables of specifications for each major test
   c. Unit tests
   d. Objective examination covering the entire course content and instructor's key
   e. Performance tests and checklists
   f. Self-administered progress checks for each major unit of instruction
   g. A plan for determining final grades
9. Course/Laboratory Management and Safety Plan
   a. Description of laboratory and/or classroom regulations
   b. List of tools and equipment required (inventory)
   c. List of consumable materials and supplies
   d. Safety regulations and practices

The quality control of courses of study is most important because this is the key document that guides instruction. To assist instructors in developing course of study with the highest quality, it is recommended that each be checked against a checklist of desirable features. One such checksheet, compiled from North Central Association and other guidelines, is provided in Figure II-11. This checksheet is intended to be used by course developers and ITE/TE program supervisors as a quality self-check.

Figure II-11

Course of Study: Quality Checksheet

Developer: ______ ____________ Course Title__________________

Course of Study Component	Not At All 1	2	3	4	Very Much So 5
1. Cover Page provides essential information	___	___	___	___	___
2. Introductory Information is clearly provided in:					
• Nature and scope of course	___	___	___	___	___
• Grade placement and prerequisites	___	___	___	___	___
• Time allotment and credit	___	___	___	___	___
3. Program Goals and Course Objectives are stated clearly					
• School or state	___	___	___	___	___
• Program	___	___	___	___	___
• Course	___	___	___	___	___
4. Content Outline is presented clearly					
• Competency list	___	___	___	___	___
• Description of content	___	___	___	___	___
5. Instructional Plan provides a clear overview					
• Major Units of Instruction are identified in sequence	___	___	___	___	___
6. Student TAMS, Projects, Assignments & Activities are identified	___	___	___	___	___
7. Teaching Resources are listed	___	___	___	___	___
8. Evaluation Plan contains:					
• Table of specifications for major evaluations	___	___	___	___	___
• Grading scheme	___	___	___	___	___
• Progress chart	___	___	___	___	___
• Test format	___	___	___	___	___
9. Course/Laboratory Management & Safety Plan is clearly described.	___	___	___	___	___

Major Units of Instruction

It is recommended that each ITE/TE course be organized into a group of major instructional units. These major instructional units are groups of lessons that have a common central theme. This theme helps pupils learn and master the competencies to be developed. Major instructional units should be long enough to cover the topics but short enough so that students never forget the unit's central unifying theme. Typically they range from one to four weeks in length. Older and/or more serious students can use longer units more effectively than less mature students.

Major instructional units should be long enough to cover the topics but short enough so that students never forget the unit's central unifying theme.

Major units of instruction typically include four key components. These components and some of their key characteristics are:

1. Title & Number of Major Unit

   The title should highlight the central theme or unifying idea for the unit. Each major unit should be able to stand alone as a mini-course.

2. Unit Objectives (Scope of Unit Statement)

   Summarize the specific outcomes of all of the lessons which make up the unit. Include understandings, skills, appreciations, attitudes. Typically such statements do **not** need to be in performance terms because the lesson's objectives will be.

3. Instructional Analysis

   A list of information and demonstration lesson plan titles presented in the sequence they will be taught. Usually they are shown in a two-column format that highlights information and demonstration categories of lesson plans. Another important characteristic is that generally the information needed for any demonstration lesson is provided prior to giving the actual demonstration lesson. Describes the manner in which the unit may best be evaluated, e.g. observation, performance test, oral reports and so on.

4. Unit Evaluation

   Sometimes specific tests, which will be used to determine the extent the outcomes of the unit have been achieved, are listed. If a pre-test is used it should be listed also. The criteria which guide advanced placement and/or testing out of the unit, as well as for final success, should be documented.

Usually it is desirable to begin a major unit of instruction with an introductory lesson. This lesson sets the stage for all the others in the major unit. It presents the theme that ties all of the unit's lessons together and it is important that this first lesson motivates students.

Major units of instruction usually end with a review and summary lesson. Often a unit post-test is used to assure mastery of the desired competencies. If however, competency attainment has been recorded all along, then unit post tests are not necessarily needed although of course they still could serve a valuable review and synthesis function.

It is also essential that instructors insure that units are not boring. Major units should not all repeat the same pattern throughout the course. Similarly, the lessons' length/scope should be varied to maintain student interest and to fit the competencies to be developed.

Often it is also desirable to plan major units of instruction that include extra lessons or modules. Some of these should be targeted on gifted or accelerated students. Typically such lessons would involve new, advanced or more in depth topics.

Then, too, instructors will often find it valuable to identify the one or two of the most difficult competencies in each unit. It is recommended that some remedial or "Plan B" lessons/modules be developed to help learners who have not mastered the competencies to, after their initial try, go at it again.

It is also essential that instructors insure that units are not boring. Major units should not all repeat the same pattern throughout the course.

Instructors will find it convenient to summarize each major unit of instruction on a one-page form. Figure II-12 shows one format that allows the instructor to record the important information about each major instructional unit. This format makes it easy to use in teaching as well as when communicating the instructional plan to interested parties.

To make it easier for instructors to make quality checks, such as the ratio of information to demonstration topics (time and number) another form, shown in Figure II-13 is useful. The major unit overview and analysis sheet shown in Figure II-13 encourages such analyses by providing space for each of the following:

1. Course and unit reference information
2. Each lesson title classified by information or demonstration type
3. The scheduled date for each lesson
4. Each lesson's time estimate and its actual time
5. Analysis of information/demonstration lesson ratio

The overview and analysis sheet also provides a system to record the instructor's estimate of teaching/laboratory time for each lesson and then another to record the actual time used. This will ease subsequent revision.

For a final, overall quality control check of their major units of instruction, ITE/TE teachers are advised to use the checksheet provided in Figure II-14.

Figure II-12

Sample Major Unit of Instruction Format

Course: ____________________ ____________________

Unit: _____ - ____________________ ____________________
(number) (unit title)

Unit Objectives: ____________________ __________
(scope of unit statement) ____________________ __________

Instructional Analysis

Demonstration Topic	Informational Topic
	1. Pretest, Introduction & Overview
	2. Lesson title . . .
3. Lesson title . . .	
	4. Lesson title . . .
	5. Lesson title . . .
6. Lesson title . . .	
	7. Lesson title . . .
	8. Review & Summary Post-Test

Evaluation: Unit will be pre-tested and post-t ested

Course Title/ No.: ____________________

Unit: ______ (Number) ____________________ (Title)

Unit Objectives: ____________________
(Scope of unit statement)

Instructional Record

Time Allotted /Used

__ Hrs. __ Min. __ Periods

Date Planned / Delivered	**Info. Topic #**	**Demo. Topic #**	**Lesson Title**	**Class**	**Lab.**	**Other**	**Total**
/				/	/	/	
/				/	/	/	
/				/	/	/	
/				/	/	/	
/				/	/	/	
/				/	/	/	
/				/	/	/	
/				/	/	/	
/				/	/	/	
/				/	/	/	
/				/	/	/	
Number of Lessons	Demons'tn	Informa'tn	Total				
Percent of Lessons	%	%	Percent	%	%	%	%

Figure II-13 Major Unit Overview Sheet

Figure II-14

Major Unit of Instruction: Quality Checksheet

Developer: ______________________________

Course Title: ____________________ Unit Title ____________________

Lesson Components	Not At All 1	2	3	4	Very Much So 5
1. Unit title is appropriate and can stand as a mini-course	___	___	___	___	___
2. Unit length is sized to suit students	___	___	___	___	___
3. Overview/Introductory lesson is incorporated	___	___	___	___	___
4. Summary/Review lesson plan is incorporated	___	___	___	___	___
5. Demonstration lessons are preceded with information lessons for prerequisite information	___	___	___	___	___
6. Overall sequence is not boring.	___	___	___	___	___
7. Lessons are manageable in size & varied in nature.	___	___	___	___	___
8. Provision is made for advanced and slower students.	___	___	___	___	___
9. Lesson objectives derive from major unit objectives and do not exceed them.	___	___	___	___	___
10. Each major unit objective is attended by one or more lesson objectives.	___	___	___	___	___
11. Provision is made for reinforcement of learning.	___	___	___	___	___
12. Unit pre- and/or post-tests are provided for.	___	___	___	___	___
13. The competencies prerequisite for unit success are identified and assessed at start of unit.	___	___	___	___	___
14. Provision is made for students to check their own progress throughout the unit.	___	___	___	___	___

Technology Activity Modules (TAMS)

Teachers of all subjects, and particularly Industrial Technology/Technology Education instructors, often attain effective results when using self-instructional modules to develop key competencies. Typical examples of useful modules include reading a ruler, converting fractions, machine components, recognition, safety, career information and the like. Such modules can be used to:

- deliver mainstream instruction
- enrich a course (provide experiences to fast-track students)
- provide remediation to make up for weak work or lacking performance
- develop prerequisite competencies necessary for success in the course
- to individualize instruction in a course
- to provide for special needs students

Generally, most modules of instruction contain much the same information, although it may be arranged in different layouts. Also, the media used may differ according to local needs or availability. For example, one school program may employ paper (printed) modules while another uses slides and tapes. Yet another may use a combination of available media up to and including interactive video. Figure II-15 provides an overview of the components used to document TAMS. Following this are some guidelines for developing each component in the module.

Generally, most modules of instruction contain much the same information, although it may be arranged in different layouts.

TAM: Cover Page

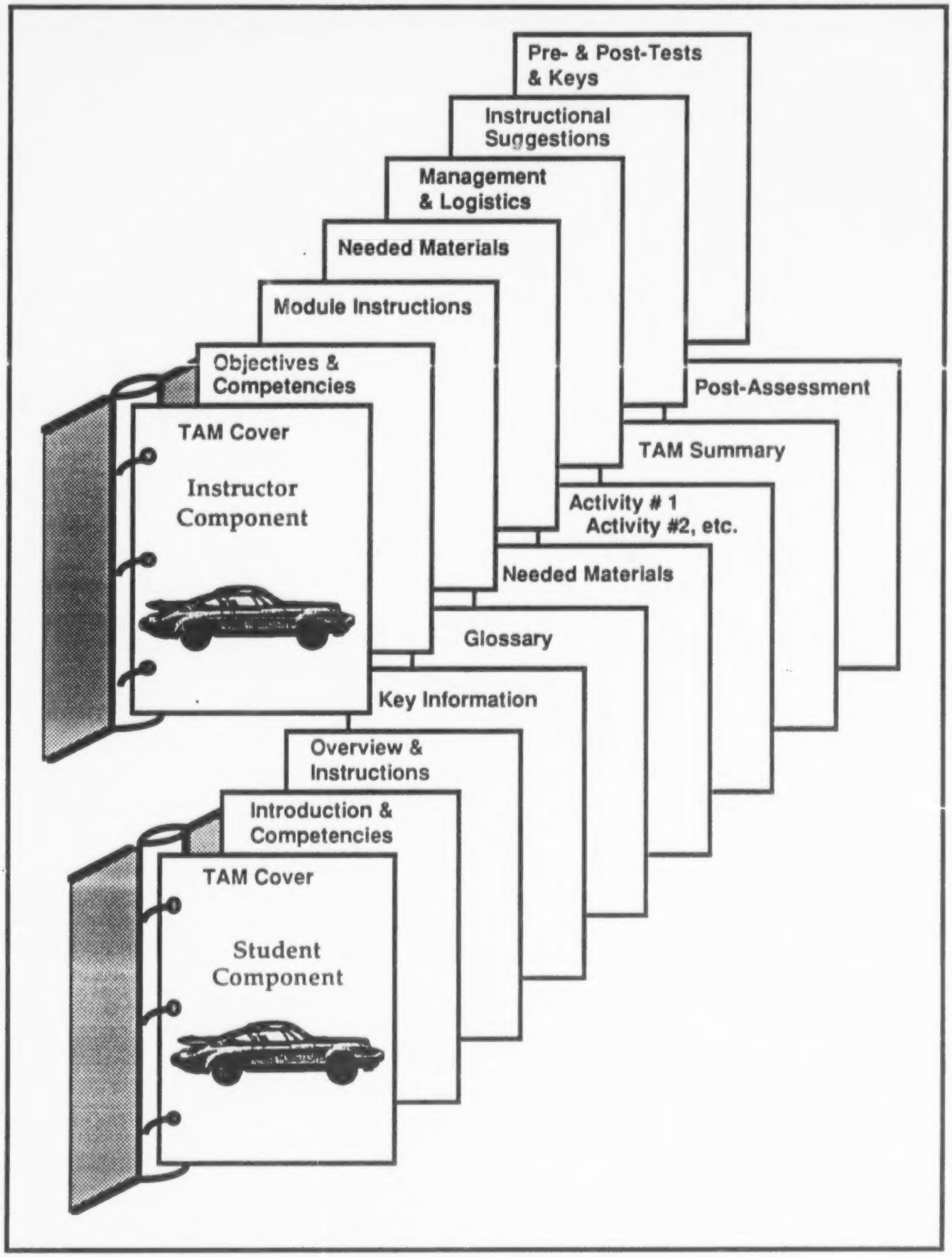
1. Title & Number
2. Course Name & Name of Major Unit of Instruction for which this TAM is intended

TAM: Instructor Component

1. TAM Title & Number
2. Activity Objective stated in instructor terms
3. Activity Competencies (student) which are to be developed by this TAM
4. Module Instructions, including, but not limited to:
    a. Introduction
    b. Safety Precautions
    c. Needed Materials for instructor to teach and students to use this TAM
        - supplies
        - equipment
        - handouts

Figure II-15

TAM Components


Pre- & Post-Tests & Keys
Instructional Suggestions
Management & Logistics
Needed Materials
Module Instructions
Objectives & Competencies
TAM Cover
Instructor Component
Post-Assessment
TAM Summary
Activity # 1 Activity #2, etc.
Needed Materials
Glossary
Key Information
Overview & Instructions
Introduction & Competencies
TAM Cover
Student Component

d. Instructional Resources for instructor to teach and students to use this TAM
  - catalogs
  - books
  - film, slides, videos
  - field trips

e. Management/Logistics suggestions to help organize this TAM's learning activities
  - related TAMS, either prerequisite or supporting or successor TAMS
  - evaluation/grading, suggestions for assessment
  - suggested time/schedule

f. Key Instructional Suggestions
  - safety
  - motivation
  - prerequisite information
  - demonstrations, hints for helping students learn safely
  - reinforcement, ideas how this TAM can be used to reinforce Missouri's key skills and core competencies
  - attitudes, ideas how this TAM can be used to develop important student attitudes
  - remediation/enrichment, ideas how slower students might be helped to master this TAM's competencies and ideas how accelerated students can build on this TAM for a more challenging activity
  - summary & review
  - review questions & answers

5. Pre-test, a diagnostic test used to assess whether students have necessary prerequisites for success in this module or whether they have already mastered it. Such pretests may be written or performance and for selected non-safety areas they may be self-scored by the students.
6. Post-test
7. Pre- and Post-test Keys

TAM: Student Component

1. TAM Title & Number
2. Introduction stated in student terms and designed to raise their interest. This section must establish, in the student's own language, the module's context. It must build student motivation and clearly demonstrate the module's relevance to the students. This section must create the perception of usefulness to the student because the instructor will not be there to do so.
3. Activity competencies (student) which are to be developed by this TAM.
4. Module Overview highlights activities. This section presents the content essential to the module. Also, it provides students with a clear list of the steps of procedure that need to be followed.
5. Module Instructions, globally outlines the sequence of activities the students are to follow.
6. Key information, include but is not limited to:
   a. Class Presentations to attend

   b. Demonstrations to be observed
   c. Safety Precautions
   d. Personal Activity related to this TAM, e.g., homework and reading
   e. Information sheets, these are often used to provide summary information or to supplement assigned readings or media.

6. Glossary defining key terms and concepts
7. Needed Materials for students to use in this TAM
   a. Supplies
   b. Equipment
   c. Handouts
8. TAM Activity Procedure Sheet(s) outlining in detail the specific steps students are to follow for each activity
9. TAM Summary
   a. Review and Summary Activities students are to follow. Because modules are self-instructional in nature, it is very important that they include a section to bring closure to the learning experience since the instructor will typically not be present to do this.
   b. Self test/Progress Check, these allow students to check their own progress. These are particularly useful in longer modules.
10. Post-Assessment
    a. Instructions for the post-test
    b. Assessment Forms
    c. Post-Test. This test is used to effectively measure student achievement (matter) of the module's objectives. Such tests may be written, performance, or observational in nature. They need to be indexed to the course/unit/ module competencies that are to be developed. Ideally, the post-test results will tell the instructor which competencies to mark as "mastered."

Lesson Plans

Most teachers will use some form of lesson plan to guide their daily instructions and to document their plans for legal, professional and other grounds. Lesson plans help teachers prepare for a lesson; they save time (after initial development); they provide a base for subsequent revisions; they facilitate instruction when teachers are ill and substitutes are used; they can be used to document performance; and they provide a convenient means to individualize instruction. It is recommended that instructors use two versions of lesson plans to document their day-to-day instruction:

- Information lesson plans provide the essential information (usually technical, guidance, or general) needed for mastery of the course competencies.
- Demonstration lesson plans guide student development of the essential sensori-motor competencies in the course.

The following pages provide explanations and instructions for developing lesson plans. Lesson plan formats can be very detailed as shown in Figure II-16 or a simplified format such as shown in Figure II-17 may be preferred. Often local school systems use their own special lesson plan format but usually the same components are involved as are used in the forms detailed here. Samples (Figures II-18 and II-19) of both information and demonstration lesson plans are provided right after these explanations.

Figure II-16

Sample Lesson Plan Format (Detailed)

Lesson Title: ____________________ Lesson Plan #______ Page #____________
Information: ______ Demonstration: ______

COURSE TITLE/NO.: ______________________________ ____________
UNIT: ________ -- ______________________________ ____________
(Number) (Unit Title)
UNIT OBJECTIVE(S): ______________________________ ____________
(SCOPE OF UNIT): ______________________________ ____________

LESSON OBJECTIVE(S):

THE STUDENT WILL BE ABLE TO:

REQUIRED RESOURCES: (Instructional Aids, Tools, Equipment, Supplies, Handouts, Etc.)

Developed By: ____________________ Date: __________ Revised: _____
Special Learning Features For: ______________________________ ______

LPF-1

Figure II-16, Continued

Lesson Title: ______________________ Lesson Plan # _____ Page #______________

INFORMATIONAL ASSIGNMENT: (Student References)

REFERENCES: (Instructor References)

INTRODUCTION: (Create perceived purpose, set induction, prepare students for the lesson)

LPF-2

80

Figure II-16, Continued

Lesson Title: ______________________ Lesson Plan #_____ Page #____________

COURSE TITLE/NO.: ______________________________ ____________

UNIT: _________ -- ______________________________ ____________
(Number) (Unit Title)

UNIT OBJECTIVE(S): ______________________________ ____________
(SCOPE OF UNIT):
______________________________ ____________

STEPS OF PROCEDURE or CONTENT OUTLINE

LPF-3

Figure II-16, Continued

Lesson Title: ______________________ Lesson Plan # _____ Page # ____________

COURSE TITLE/NO.: ______________________________ ____________

UNIT: _________ -- ______________________________ ____________
(Number) (Unit Title)

UNIT OBJECTIVE(S): ______________________________ ____________
(SCOPE OF UNIT):
______________________________ ____________

INTERACTION ITEMS: (To be keyed for use during presentation)

CLASSROOM, LABORATORY, OR OTHER ACTIVITIES:

EVALUATION ITEMS:

LPF-4

Figure II-16, Continued

Lesson Title: ______________________ Lesson Plan #______ Page # ____________

COURSE TITLE/NO.: ______________________________ ______________

UNIT: _________ -- ______________________________ ______________
(Number) (Unit Title)

UNIT OBJECTIVE(S): ______________________________ ______________
(SCOPE OF UNIT):
______________________________ ______________

REVISION NOTES: (This page is used to record instructor and student feedback for subsequent lesson plan revisions. Test keys are also recorded on this page.)

1. **Student Feedback**

2. **Revisions to be made**

3. **Test/Assignment keys**

LPF-5

Figure II-17

Sample Lesson Plan Format (Simplified)

Course: ______________________ **Unit #:** __________

Unit: ______________________ **Lesson Plan #:** __________

Lesson Topic: ______________________

Objective(s): ______________________

Resources: (Tools, equipment, supplies) ______________________

Instructional Approach: ______________________

Content Outline (or Steps of Procedure): ______________________

- **Introduction:** ______________________
- **Content:** ______________________
- **Summary:** ______________________

Learning Activities: ______________________

Evaluation: ______________________

Interaction Items: ______________________

Because lesson plans are typically the single most important determinant of quality in day-to-day instruction, it is crucial that they are developed properly. The following guidelines and instructions[1] will help industrial technology/technology education teachers maximize the quality of their lesson plans:

Instructions: Lesson Plan Page 1 (White)

DOCUMENTATION BLOCK	
• Lesson Title	This should describe the lesson's content and should be stated to raise student interest in the topic.
• Lesson Plan #, Page #	Consecutively number the lesson plans in each major unit of instruction. Also number the pages within each lesson.
• Information or Demonstration Type	Check to indicate the type of lesson. Information lessons provide needed cognitive and affective information. Demonstration lessons develop a manipulative skill in a step-by-step manner.
• Course Title/No.	List as your courses appear in your school/institution catalog.
• Unit #, Title	Documents which unit (title & #) of your course this lesson belongs to.
• Unit Objectives (Scope of Unit Statement)	This statement lists objectives the teacher desires to achieve in the unit. It is a summary of the theme that ties all of the lessons together to provide continuity. This remains the same for each lesson plan within a unit.
LESSON OBJECTIVE(S)	Describes the performance(s) expected of the students upon successful completion of the lesson. It/they should be listed in performance terms with clear behavior, conditions and criteria for success.
REQUIRED RESOURCES (Instructional aids, tools)	List all items needed to teach the lesson. This becomes a checklist to insure readiness.
DEVELOPED BY	Indicates the author of the lesson plan.
DATE WRITTEN/REVISED	Indicates date of lesson plan writing/revision.
SPECIAL LEARNING FEATURES	Lists the special learning features that this lesson has built into its delivery system, i.e. group/individual instruction, hearing difficulties, reading difficulties

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[1] Adapted from King, 1975.

Instructions: Lesson Plan Page 2 (White)

INFORMATIONAL ASSIGNMENT .... List the exact book, author and page numbers of the material you wish the student to read. List all other materials on a similar basis.
(Student references, text, reference books, information sheets, etc.)

REFERENCES .... List all of the references and page numbers you used in the preparation of the lesson. When you need to review or revise a lesson, you can get to this exact reference and pages quickly.
(Instructor references)

INTRODUCTION............................ Prepare the student to listen to and participate in the lesson. Tell the importance of, the reasons for, and the use of, the instruction which will follow. Create perceived purpose.

Instructions: Information/Demonstration Lesson Plan Page 3 (Yellow or Green)

DOCUMENTATION BLOCK .... Complete the spaces provided at the top of each page for easy filing and retrieval of your lesson plans and to avoid mixup of lesson plan pages.
(Lesson Plan #, Page, Title, Major Unit Name)

CONTENT OUTLINE .... Used for information-type lessons. Information is best organized in outline form. The style may be topical in format, e.g.:
(Yellow)

I. Definition of Terms
  A. Technology
  B. Industry

Alternatively, it may be in sentence format, e.g.:

I. For understanding the material, it is essential to be able to define the terms of the occupation.
  A. Technology is a term used ...
  B. Industry refers to ...

Remember: Teach from the outline—don't read it to sleeping students. Be certain to include a review and summary. Use as many pages of content outline as you need and number them consecutively.

-OR-

STEPS OF PROCEDURE (Green)	To be used when preparing and demonstrating a manipulative-type skill. List the steps of your demonstration in the order performed. Example: Step #1 - ... Step #2 - ... to Final Step - ...

Instructions: Lesson Plan Page 4 (Blue)

DOCUMENTATION BLOCK	Complete the spaces provided at the top of each page for easy filing and retrieval of your lesson plans and to avoid mixup of lesson plan pages.
INTERACTION ITEMS	Keep up student interest by listing and asking questions about key points. Answer your own question if you like! These items are great for class discussion, too. Provide yourself a clue as to when to ask interaction items by penciling a note on your lesson outline. Note! By preparing questions in advance, you will ask better questions.
CLASSROOM, , LABORATORY OR OTHER ACTIVITIES	Design assignment activities to supplement your instruction. Give each student a chance to apply the lesson content. Examples of activities are: demonstrations, reports, group discussion, role-playing, field trips, etc. Plan, list, and assign activities - watch students learn! If you prefer to use separate sheets for such assignments just list them here and insert these sheets following this lesson plan page.
EVALUATION ITEMS (Oral, written or performance to measure attainment of lesson objectives)	You must evaluate student accomplishment of the lesson objectives. An ideal time to plan your evaluation is when you first finish writing your lesson content. You should list items to measure desired outcomes before instruction begins. Your objectives tell what the students are expected to be able to do, your content tells what is important, interaction items emphasize key points of the lesson and activities reinforce instructions and learning. Write test items to measure the specified objectives in the form and type best suited to each objective - oral, written or performance.

At test time, select items from those you have written. It is a great feeling to prepare a test over the exact materials covered.

Instructions: Lesson Plan Page 5 (White)

DOCUMENTATION BLOCK	Complete the spaces provided at the top of each page for easy filing and retrieval of your lesson plans, and to avoid mixup of lesson plan pages.
• Revision Notes	These summarize your plans, as ideas come to you, for the revision of the lesson. The best time to make these is right after you have taught the lesson. Include input from students and follow-up effectiveness assessments.
• Test/Assignment Keys	This space provides a convenient place for recording this important information.

The preceding instructions serve as a guide to developing quality lesson plans in a very detailed form. Often even good ITE/TE instructors find their time at such a premium that it will not permit such a high level of detail. Despite this, instructors are encouraged to start out using this format, but perhaps only developing the objectives, set and content outline sections at first. Then in subsequent years, or when time permits, one can gradually add to the documentation and develop a complete package. Figures II-18 and II-19 provide one-page examples of short format lesson plans that might be appropriate for a beginning.

While developing a set of lesson plans using the preceding instructions, ITE/TE teachers are advised to check the quality of what they have developed. The Lesson Plan Quality Checksheet, shown in Figure II-20, provides a convenient way to insure lesson quality. It is recommended that from time to time, instructors take the time to use the checksheet on a sample of the lesson plans. Using the forms provided in Figures II-16 and II-17 also helps us by providing a standardized format.

Figure II-18

Sample Information Lesson Plan Format[1]

COURSE: Introduction to Technology   Unit #: 7

UNIT: Employability Skills   Lesson Plan #: ____

LESSON TOPIC: Ways of Getting a Job: The Resumé

OBJECTIVE(S):	Given four sample resumés, the student will develop his/her own resumé containing complete information in each of the necessary categories as indicated by the samples.
RESOURCES: (Tools, Equipment, supplies)	Copies of four teacher-prepared sample resumés for each student.
INSTRUCTIONAL APPROACH:	Presentation/Discovery Supervised Individual Activity
CONTENT: • Introduction	This past week we have been talking about various ways of getting a job. Today, I want you to assume that you will be completing school soon and consequently you have been watching the "help wanted" column in the local newspaper. This morning you noticed a job opening that appeals to you, but the ad suggests that you send a resumé to box 47 in care of that paper.
• Content	Resumés communicate....; Proofread your resumé...
• Summary	You have covered ...
LEARNING ACTIVITIES:	Students will study the four samples individually to discover for themselves the types of information contained in a resumé and the format required.
(20 minutes)	Based on what they have discovered, each student will prepare his/her own resumé.
EVALUATION: (15 minutes)	Students will pair off, trade papers and discuss each resume, evaluating the completeness of each On the basis of the four samples. Each student will then make a final draft of his/her resumé incorporating any necessary revisions. Final evaluation will be made by the teacher using the four samples as guidelines.
INTERACTION ITEMS: (15 minutes)	#1 What was the objective of this lesson? #2 What information should a resumé contain? #3 Why should attention be given to the preparation of the resumé?

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[1] Adapted from *Develop A Lesson Plan.* Module B-4. Performance Based Teacher Education Module Series. Columbus, Ohio: The National Center for Research in Vocational Education, Second Edition.

Figure II-19

Sample Demonstration Lesson Plan Format[1]

COURSE: Any Course Unit #: 2

UNIT: Basic Machine Operation Lesson Plan #: ______

LESSON TOPIC: Operating a . . .

OBJECTIVES:	These list what is to be achieved as a result of the lesson. They should be brief and concise.
RESOURCES: (Tools, Equipment, supplies)	Lists tools, equipment and supplies needed to teach the lesson.
INSTRUCTIONAL APPROACH:	Demonstration followed by student "walk throughs."
INTRODUCTION:	States specifically how student attention is to be obtained and how interest is to be developed. This step may be any length but is usually three to five minutes duration. This step should lead smoothly into the presentation of procedures step.
STEPS OF PROCEDURE:	Lists each step and key point necessary to perform the operation or operations. Length of presentation typically ranges 30 to 45 minutes. State steps clearly and concisely in occupational/ technological terms. List steps in proper sequence. Number each step consecutively. Key points should be listed with steps where they apply.
SUMMARY:	This draws together the lesson's key points and it prepares students for their assignments!
LEARNING ACTIVITIES:	Student is assigned an activity (e.g., experiment, project, problem, etc.) from the course of study, involving the operation or operations presented. Supply student with the appropriate information handouts or have student review the assigned readings/media. Effectively motivate students when making job assignment. The job assignment should be such that it can be completed within an appropriate time. The instructor supervises the work but should not work on the student's job. Provision for individual differences should be made.
EVALUATION:	Check quality, time and techniques. Criteria for checking are to be based on acceptable standards. A checklist is recommended to insure reliability.
INTERACTION ITEMS:	These are keyed to the steps of procedure in order to prompt student thinking.

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[1] Adapted from *Develop A Lesson Plan*. Module B-4. Performance Based Teacher Education Module Series. Columbus, Ohio: The National Center for Research in Vocational Education, Second Edition.

Figure II-20

Lesson Plan: Quality Checksheet

Developer: ______________ Lesson Plan Title: ____________ Unit Title: ______________

Components	Not At All 1	2	3	4	Very Much So 5
1. Major Unit Title is entered correctly.	___	___	___	___	___
2. Scope of Unit statement provides an overview of all lesson in the major unit and is keyed to one or more course objectives.	___	___	___	___	___
3. Information Lesson or Demonstration Lesson blank has been numbered to indicate its order in the major unit.	___	___	___	___	___
4. Lesson Title is concise, descriptive, challenging to the student and is identified in the instructional analysis.	___	___	___	___	___
5. Lesson Objective(s) identify the performance, conditions and criterion level expected.	___	___	___	___	___
6. Required Resources, Teaching/Learning items have been identified.	___	___	___	___	___
7. Information Assignments and References have been listed with page numbers.	___	___	___	___	___
8. Introduction creates interest, explains what, why, when, where, and how this lesson is being presented.	___	___	___	___	___
9. A. Information Lessons present the content in outline form	___	___	___	___	___
or					
B. Demonstration Lessons present the steps of procedure in the skill and these are listed in prerequisite order.	___	___	___	___	___
10. Interaction Items have been listed as questions and keyed to the lesson.	___	___	___	___	___
11. Classroom, Laboratory, or Other Activities have been identified for immediate application of the lesson content.	___	___	___	___	___
12. Evaluation Items are developed to measure student attainment of each lesson objective, and keys are provided on the teacher's lesson plan page.	___	___	___	___	___

Performance Objectives

Throughout the curriculum documentation process, instructors will need to develop performance objectives. Usually these will be used in lesson plans and self-instructional modules. Such objectives must clearly indicate:

- The desired performance to be learned and demonstrated.
- The conditions under which the performance is to be learned or tested.
- The criterion or standard which will be used to judge the success of the performance, i.e., to decide whether the student demonstrated mastery of the desired competency.

It is highly recommended that instructors analyze the list of cognitive, affective, and psychomotor objectives they have in each of their major units of instruction. To do this, after each major unit's lessons have been developed, i.e., objectives have been specified, instructors often classify them by domain and level. The goal is to avoid an imbalance of objectives in any one domain or a predominance of objectives at low levels of any domain. The following summary of key domain and level characteristics is provided to help in analyzing instruction objectives.

Educational objectives have been classified into three domains: cognitive, affective and psychomotor. The cognitive domain includes those educational objectives related to the recall of knowledge and the development of intellectual abilities. The affective domain involves values, attitudes and changes in a pupil's emotional state. The psychomotor domain includes objectives that involve primarily muscular or motor skills, some manipulation of material and objects, or some act that requires a neuromuscular coordination (adopted from Krathwohl and others, 1964, p. 7). The taxonomies, i.e., classification systems, are each organized into a hierarchy or specialized capabilities within each domain as shown in Figure II-21.

It is highly recommended that instructors analyze the list of cognitive, affective, and psychomotor objectives they have in each of their major units of instruction. The goal is to avoid an imbalance of objectives in any one domain or a predominance of objectives at low levels of any domain.

The checksheet in Figure II-22 provides a way for instructors to monitor and maximize the quality of their objectives. The checksheet's scales are self-explanatory and should be applied to a sampling of objectives listed in each course's major units, lesson plans and/or modules.

Figure II-21

Cognitive, Affective and Psychomotor Domains of Education Outcomes

Cognitive Domain. The taxonomy for the cognitive domain contains six subdivisions and these in turn are further divided into more specific divisions. The six main subdivisions are as follows:

1.00 KNOWLEDGE

The recall of specifics and universals, the recall of methods and processes, or the recall of a pattern, structure, or setting.

2.00 COMPREHENSION

A type of understanding or comprehension such that the individual knows what is being communicated and can make use of the material or idea being communicated without necessarily relating it to other material or seeing its fullest implications.

3.00 APPLICATION

The use of abstractions in particular and concrete situations. The abstractions may be in the form of general ideas, rules of procedures, or generalized methods.

4.00 ANALYSIS

The breakdown of a communication into its constituent elements or parts such that the relative hierarchy of ideas is made clear and/or the relations between the ideas expressed are made explicit. Such analyses are intended to clarify the communications, to indicate how the communication is organized and the way in which it manages to convey its effects, as well as its basis and arrangement.

5.00 SYNTHESIS

The putting together of elements and parts as to form a whole. This involves the process of working with pieces, parts, elements, etc. and arranging them in such a way as to constitute a pattern or structure not clearly there before.

6.00 EVALUATION

Judgments about the value of material and methods for given purposes. Quantitative and qualitative judgments about the extent to which material and methods satisfy criteria.

Affective Domain. In this taxonomy, which classifies levels of attitudes, values and preferences, five main subdivisions have been identified (Krathwohl et al., 1964, pp. 176-185).

1.00 RECEIVING (ATTENDING)

The sensitization of the learner to the existence of certain phenomena and stimuli. He/she is willing to receive or to attend to them. This is the first and crucial step if the learner is to be properly oriented to learn what the teacher intends.

2.00 RESPONDING

Pupil responses that go beyond merely attending to the phenomenon. The pupil is sufficiently motivated that he/she is not just willing to attend but to attend actively. This is the category that many teachers find best describes their "interest" objectives.

3.00 VALUING

Recognition that a thing, phenomenon, or behavior has worth. This abstract concept of worth is in part a result of the individual's own valuing or assessment, but it is much more a social product that has been slowly internalized or accepted and has come to be used by the pupil as his/her own criterion of worth. This category is appropriate for many objectives using the term "attitude" and, of course, "value."

Figure II-21, Continued

Cognitive, Affective and Psychomotor Domains of Education Outcomes

4.00 ORGANIZATION
The beginnings of the building of a value system. As the learner successively internalized values, he/she encounters situations for which more than one value is relevant. Thus the necessity arises for (a) the organization of the values into a system, (b) the determination of the interrelationships among them, and (c) the establishment of dominant & pervasive ones.

5.00 CHARACTERIZATION BY A VALUE OR VALUE COMPLEX
Integration of beliefs, ideas, and attitudes into a total philosophy or world view. The values already have a place in the individual's value hierarchy, are organized into some kind of internally consistent system, have controlled the behavior of the individual for a sufficient time that he/she has adapted to behaving this way, and an evocation of the behavior no longer arouses emotion or affect except when the individual is threatened or challenged.

Psychomotor Domain. Clearly there exists no single preferred classification for sensori-motor behavior. However, one approach, based on the degree of complexity in psychomotor behavior, was developed by Simpson (1966). Attention is on the sequence involved in learning motor acts (skills). Seven major steps are involved in her taxonomy:

1.00 PERCEPTION
The process of becoming aware of objects, qualities, or relations by way of the sense organs. It is a necessary, but not sufficient, condition for motor activity and it is basic in the situation --> interpretation --> action chain leading to motor activity.

2.00 SET
Preparatory adjustment or readiness for a particular kind of action or experience (mental, physical, or emotional).

3.00 GUIDED RESPONSE
An early step in the development of skill. Emphasis is on the abilities that are components of the more complex skill. Guided response is the overt behavioral act of an individual under the guidance of the instructor or in response to self-evaluation where the pupil has a model or criterion against which he/she can judge his performance.

4.00 MECHANISM
Achievement of a certain confidence and degree of proficiency in the performance of the act. The act is a part of the learner's repertoire of possible responses to stimuli and the demands of situations where the response is an appropriate one.

5.00 COMPLEX OVERT RESPONSE
Attainment of skill. The individual can perform a motor act that is considered complex because of the movement pattern required. The act can be carried out smoothly and efficiently.

6.00 ADAPTATION
Altering motor activities to meet the demands of new problematic situations requiring a physical response.

7.00 ORIGINATION
Creating new motor acts or ways of manipulating materials out of understandings, abilities, and skills developed in the psychomotor areas.

Figure II-22

Performance Objective: Quality Checksheet

Developer: ____________ Lesson Plan Title: ____________ Unit Title: ____________

Components	Not At All 1	2	3	4	Very Much So 5
1. Performance - Does the objective describe what the learner will be doing to demonstrate that he/she has attained the objective? The objective specifies what the learner is to do and not what the teacher is going to do?	___	___	___	___	___
2. Condition - Does the objective specify the important conditions under which the learner must demonstrate his/her competence?	___	___	___	___	___
3. Criterion - Does the objective describe the criteria by which the learner's performance proficiency can be judged?	___	___	___	___	___
4. Preciseness and Clarity - Has the objective been specified using action words and leaving no opportunity for misinterpretation?	___	___	___	___	___
5. Success Expectation - Has the objective been stated with sufficient detail to assure that the expected performance outcome can be recognized?	___	___	___	___	___
6. Completeness, relevance and achievability - Is each objective completely stated, relevant to the course and achievable in the student's eyes?	___	___	___	___	___

8. Resources

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Chapter III

Planning Industrial Technology/Technology Education Facilities

COMMUNICATION
TECNOLOGY
CAM
ROBOTICS

Chapter III

Planning Industrial Technology/ Technology Education Facilities

1. Introduction & Overview

Implementing is making it happen. It involves moving the instructor's dreams, aspirations and hopes into reality. And in ITE/TE the only reality that counts is what happens with students in our laboratories.

- Theory doesn't count,
- Hopes and wishes don't amount to anything, and
- Intentions are of little value.

What *actually* happens to the youth in our charge is what counts — it is our *only* reality. Our challenge is to make this reality match our professional goals and build a sound curriculum. Chapter II detailed how such a curriculum could be built. But there is more to success than just having a good curriculum – particularly in ITE/TE programs. We need proper technological facilities, up-to-date equipment, ongoing maintenance, a systematic safety program, and a public relations program. Together these can implement a sound program that makes dreams become reality.

Chapter 3 Outline

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Facilities are a big part of ITE/TE. They can certainly contribute to the success or failure of a program. By themselves, however, facilities, either good or bad, are seldom sufficient to make or break a program. Instructors face one of two situations with respect to facilities:

- They can find themselves in an existing facility that they will have to live with — although renovation is always possible.
- They can find themselves involved in establishing brand-new facilities.

Most instructors will find the former to be the case and part 2 of this chapter addresses this situation. Consequently this guide will also emphasize this section. However, the principles involved in planning new facilities, provided in this chapter's part 3, also apply to the planning of renovations. Thus, both parts 2 and 3 of this guide will be useful to instructors seeking to enhance their program.

2. Objectives of the Section:

The objectives of the facilities section of the guide are to:

1. Provide important background information for the facility planning process.
2. Suggest strategies for linking curriculum and facility planning.
3. Present some alternative facility plans and concepts including ideas for low-cost implementation.
4. Outline educational specifications affecting facility design.
5. Discuss design characteristics.
6. Provide a listing of resources which could be accessed for facility design.

3. Background Information

Curriculum Changes Mean Changing Environments

Over ten years ago, Dr. Ron Todd (27th Yearbook, American Council on Industrial Arts Teacher Education) stated:

> Learning environments in the future will take on more divergent forms than what are presently in use. Alternative programs will begin to make quiet, yet demanding changes on standard facilities. In fact, the standard facility as an idea will eventually pass. This does not mean that space design and location are insignificant, but that existing facilities can be made into ***exciting*** places for learning despite their original state. If a new standard facility does emerge it will essentially be a flexible one.

Clearly the future is here! Major curriculum changes are placing new and exciting demands on learning environment design. The implications go beyond remodeling around a few new additions such as computers, mouse trap vehicles, etc. More significantly, it is important that facilities be designed to be "quick on their feet" as technology continues to expand and change. In a very real sense—the future is now! The implications for facility change are real.

Trends in ITE/TE Facility Design and Equipment

There is a clear trend towards the establishment of cluster laboratories in Industrial Technology/Technology Education. Often such facilities are large enough to allow sub-division by partitions (as long as building codes are maintained!) that divide comprehensive laboratories into more specialized facilities. For example, a comprehensive materials and processing laboratory may be sub-divided into unit laboratories for areas such as manufacturing, construction and materials testing. Similarly, an energy & power facility may be divided into fluidic, engine and electronics laboratories, or a communication laboratory may be divided into unit facilities for visual, audio and telecommunications.

Today the best new facilities are provided with modular utility systems that enhance flexibility making rearrangement of the laboratory easier. Also important to flexibility is the use of portable equipment and tool storage. Roll-around cabinets, carefully tailored storage systems, and tables are often used to tailor instruction in varying areas of the facility.

Modular and table-top technology equipment are found much more frequently in today's facilities as are industrial design-based signage systems and bright colors. Multiple activity areas are used to give contemporary facilities a "laboratory" look as contrasted to yesterday's "shop." Of course cleanliness has much to do with this but so does the choice of bench-top and flooring materials. Colorful plastic laminates are prevalent and commercial carpeting is not at all inappropriate for some areas.

More and more simulators, trainers and computers are used to address the challenges of new technology. Generally instructors are turning to smaller equipment and less multiples of any single item. Instead, a greater ***variety*** is purchased in order to help students develop a better appreciation of the tremendous breadth of today's and tomorrow's technology.

Types of Space Needed to Deliver ITE/TE

One of the important changes affecting ITE/TE laboratories in recent years has been an expansion in *Types of Space* that are required to deliver the curriculum. Among the space types which should be considered during the facility planning process are:

- Group instructional areas (auditorium, traditional classroom, reconfigurable space)
- Individual instructional areas (e.g., audio-visual workstations, carrels)
- Pairs
- Storage (hazardous materials, student records, project storage, software, supplies, tools)
- Cleanup
- Outdoor
- Specialized/dedicated, e.g.,
  - Darkroom
  - Recording studio
  - Controlled ventilation
  - Biodome
  - Foundry
  - Display
  - Automated flexible manufacturing or CIM cell
  - Solar or alternative energy area
  - Loading/receiving
  - Instructor's office
  - Student conference area
  - Library/resource area
  - Computer work stations
  - Video production area
- Research and development space
- Design and prototyping
- Media presentation
- Study space

Types of Industrial Technology/Technology Education Facilities

When looking at the profession's activity across the nation, it seems clear there is a trend toward cluster courses in Industrial Technology/Technology Education. These are typically implemented in three distinct kinds of ITE/TE laboratories. They are: the comprehensive laboratory, the cluster laboratory, and the technological specialization laboratory.

Comprehensive Laboratories

As the name implies, this type of laboratory is designed to be able to contain a range of activities in one facility. Comprehensive laboratories are used to deliver courses typically using the ***Multiple Activity Approach***. Often such labs designate space for each of the three clusters in Industrial Technology/Technology Education including Materials and Processing, Energy and Power, and Communication. The laboratory size can vary from small to large. The distinguishing feature is that they are single facilities which have been configured and equipped to deliver learning experiences across the entire range of technology.

Cluster Laboratories

The Cluster type of laboratory is a derivative of the comprehensive laboratory. Its primary feature is that it implements a single technological cluster (i.e., Materials and Processing, Energy and Power, and Communication). Within such laboratories separate space is typically designated for specialized types of equipment or activities, such as a dark room area in a Communication laboratory or a non-destructive materials testing area in the Materials & Processing area.

> **Across the nation, there is a clear trend toward cluster courses in Technology Education.**

Technological Specialization (Unit) Laboratories

Historically, most Industrial Arts laboratories have been of this type. Specialization laboratories are designed to deliver in-depth instruction in a particular area of technology. Traditional examples have included woodworking and machine shops. As the curriculum has changed to reflect a broader range of technology, there is less need for this type of configuration. They do, however, remain useful for Level III pre-vocational and potentially even tech-prep courses at the upper grade levels.

Updating Existing Facilities

How does one best update an ITE/TE program? Certainly the curriculum recasting outlined in chapter II is an important start. However, ***another*** important dimension is the facility in which the curriculum is taught. Furthermore, facility updating is often the easiest and most effective means of injecting new life and excitement into an older, perhaps even stale, program. Because facility changes are so visible, even relatively small improvements will often have significant effects on students, colleagues and administrators. It is amazing to see what a robot, a computer, or a new machine can do.

Teachers should not imagine that facility updating necessarily demands great investment. To the contrary, often a coat of paint or simple reorganization of existing resources will accomplish much of what is desired. Only after reorganization has reached its limits does renovation need to be considered. Even this however, is not to be feared for much can be accomplished with relatively minor expense. Examples might include such things as opening a doorway between two adjacent laboratories, adding an outdoor area for construction or alternative energy activities, establishing a darkroom and the like. Schools have a large investment in existing facilities and with some work, most of these could be reworked to provide the type of facility needed to support a quality ITE/TE program.

Even small improvements can have a significant effect on students, colleagues, and administrators.

Reorganization

Reorganization of facilities is the easiest and least expensive way to program updating. Often it is what administrators need to see before they are convinced that the teacher is serious about program improvement. Once this becomes clear, increased levels of support typically follow.

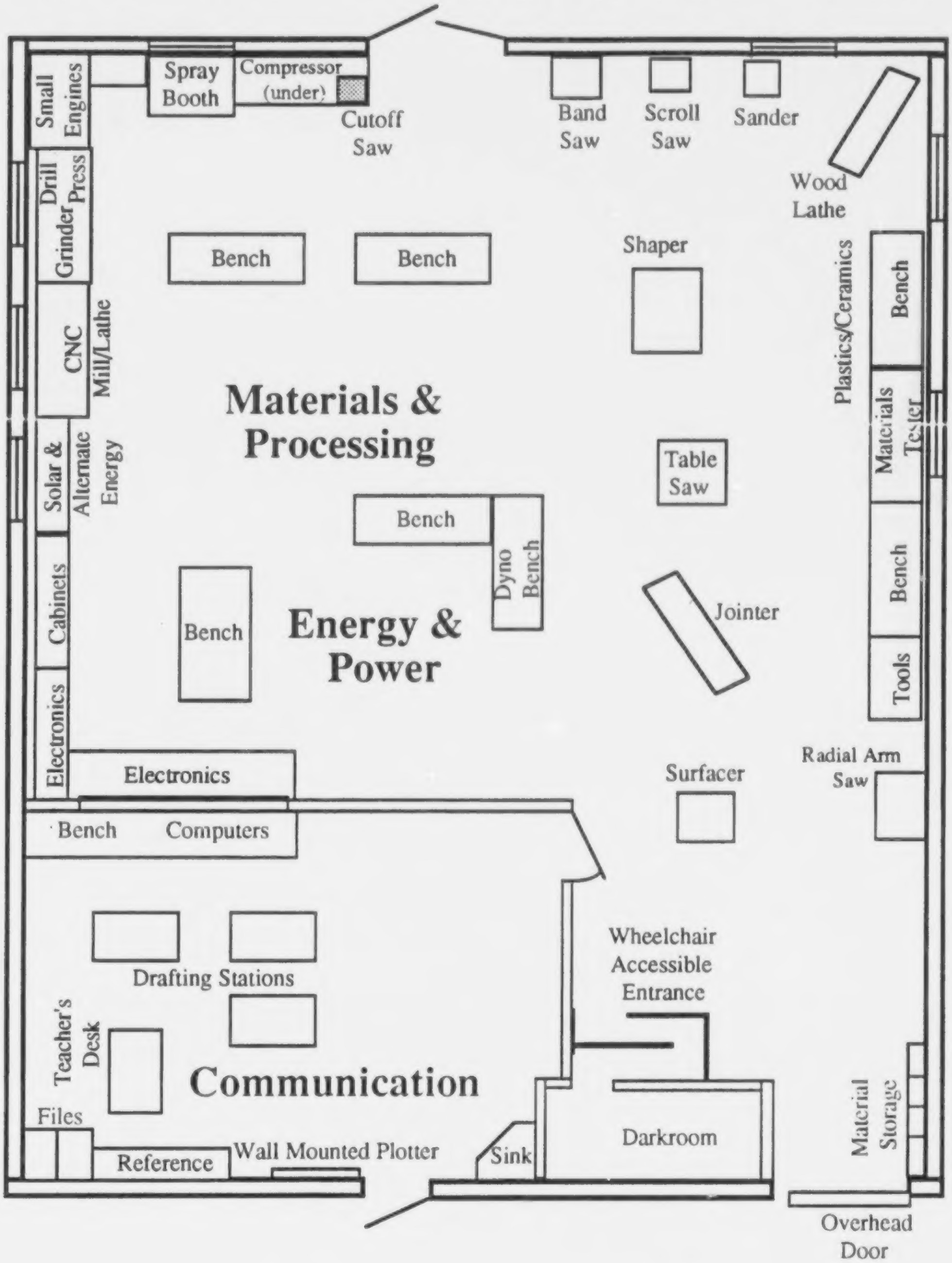
The key to modernization is to begin by looking closely at what is already available rather than starting with a major renovation or a new facility.

In some cases extensive remodeling may not be necessary. Instead a reorganization of existing space will meet the demands of a new curriculum approach. Many laboratories are not making maximum utilization of available space. Space may be opened up by rearranging machines and equipment. Flexibility may be obtained by providing flexible hose connections to exhaust outlets and connecting flexible plug-in power modules. Integrating the woods, plastics and metals areas into a Materials and Processing laboratory may be done by adding a doorway between areas. New color code schemes, removing obsolete equipment and converting large benches into smaller units to form different configurations are a few more ways to improve a facility without great expense.

Figure III-1 shows a small junior high school lab which was limited in space thus restricting the possibility of giving the students a new program based on a study of industry. The space was only large enough to handle basic woodworking. With a few minor changes the area became more open and flexible as well as adding some plastics, metals, graphic arts and a planning center. A clean area for communication technology and planning was created with some 10 foot high walls equipped with extensive glass areas to facilitate class control. A closet was converted into a darkroom and overhead space was used for mezzanine storage of supplies and infrequently used tools. Table-top technology systems (CNC, plastics, desktop publishing, ...) were added to broaden the once narrow curriculum.

Figure III-1

Updated Industrial Technology/Technology Education Laboratory


Small Engines
Spray Booth
Compressor (under)
Cutoff Saw
Band Saw
Scroll Saw
Sander
Wood Lathe
Drill Press
Grinder
Bench
Bench
Shaper
Plastics/Ceramics
Bench
CNC Mill/Lathe
Materials & Processing
Materials Tester
Solar & Alternate Energy
Table Saw
Bench
Dyno Bench
Cabinets
Bench
Energy & Power
Jointer
Bench
Tools
Electronics
Electronics
Surfacer
Radial Arm Saw
Bench
Computers
Drafting Stations
Wheelchair Accessible Entrance
Teacher's Desk
Communication
Material Storage
Files
Reference
Wall Mounted Plotter
Sink
Darkroom
Overhead Door

Additional reorganization amounted to the removal of some walls and the addition of overhead service systems. Each of the large bench units was split in half to provide work areas throughout the laboratory. The bench units became work modules which could be ***moved*** anywhere in the laboratory to form different work area configurations. It was not necessary to provide a lecture space in this shop because it could be done in a separate room (adapted from Stallsmith, 1977, pp. 30-40).

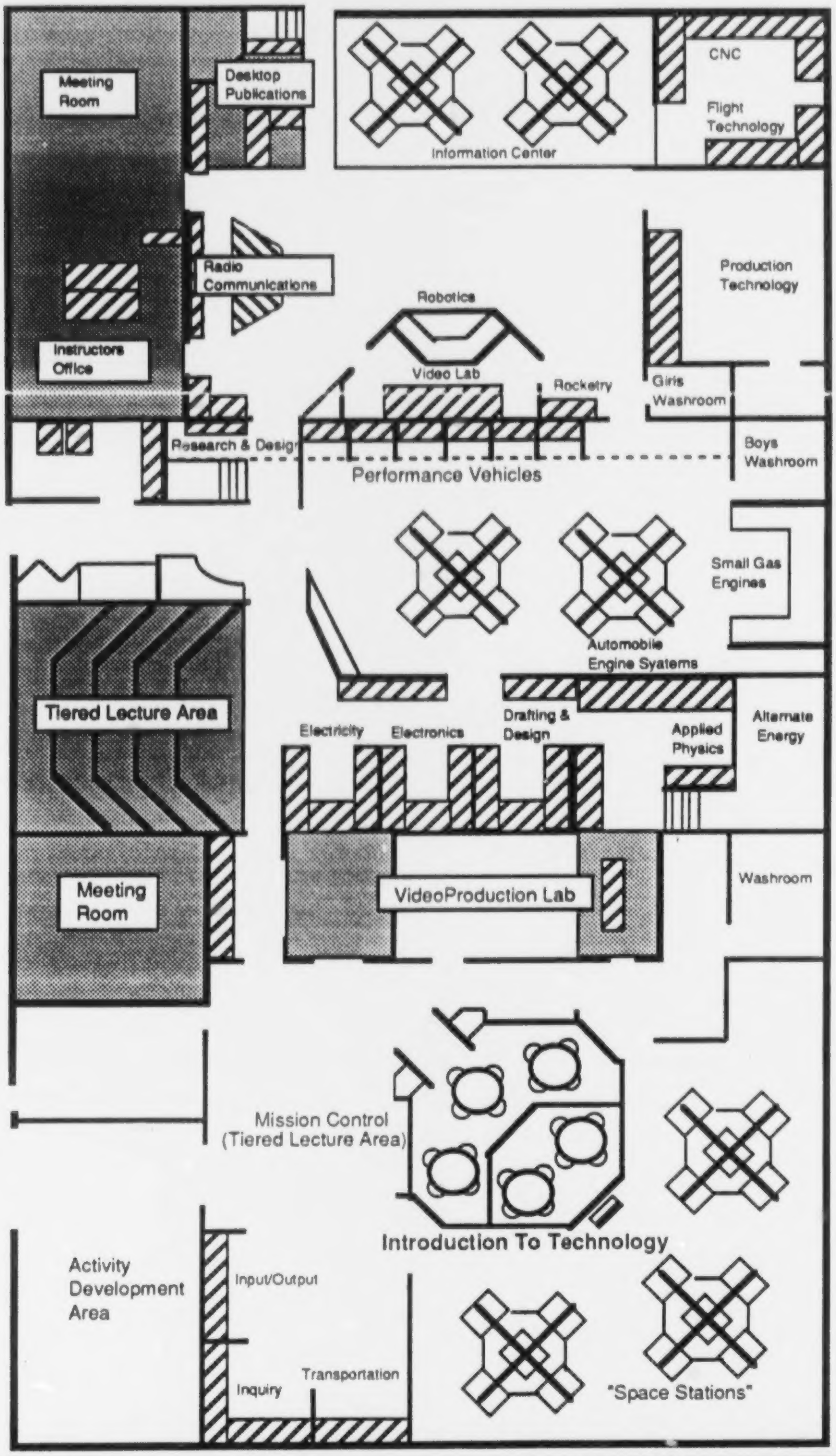
Perhaps the nation's outstanding example of what can be accomplished by modernization is shown in Figure III-2. This two-teacher facility was created from a pair of traditional industrial arts woodworking and small engine shops. A complete description of this facility and curriculum overhaul can be found in the February 1987 issue of The Technology Teacher (pp. 23-30) and instructors are encouraged to review their approach in depth.

Renovation

Before beginning facility renovations, instructors are advised to use the Missouri ITE Standards (available from the Missouri State Supervisor of ITE), to assess their facility's current status. This will provide an excellent base of information upon which to plan the renovation of instructional facilities. To establish the necessary base, it is recommended that ITE/TE teachers:

- Use the Missouri ITE standards to assess the existing facility's strengths and weaknesses with respect to the curriculum they have planned as per Chapter II.
- Analyze the program's safety requirements.
- Assess the technological relevance of their facility.
- Consider the requirements of the various media (VCR, slide-tape, film, self-instructional carrels, computer) they wish to use to deliver instruction.
- Consider team teaching and its facility implications.
- Review the requirements of their instructional and facility management systems.
- Consider the facility's visual impact and public relations effect.

Figure III-2
Technology Education Laboratory
Pittsburg Middle School, Pittsburg, KS


Meeting Room
Desktop Publications
Information Center
CNC
Flight Technology
Radio Communications
Robotics
Production Technology
Instructors Office
Video Lab
Rocketry
Girls Washroom
Research & Design
Boys Washroom
Performance Vehicles
Small Gas Engines
Automobile Engine Systems
Tiered Lecture Area
Electricity
Electronics
Drafting & Design
Applied Physics
Alternate Energy
Meeting Room
VideoProduction Lab
Washroom
Mission Control (Tiered Lecture Area)
Introduction To Technology
Activity Development Area
Input/Output
Inquiry
Transportation
"Space Stations"

Wisconsin's facility guidelines[1] highlight another most important concern in the planning process, namely the student. "If the student's needs and concerns are not recognized the basic purpose for which the facility is planned will be defeated. A facility should motivate the student to learn and become aware of what this environment has to offer. It should be a laboratory for learning with action-oriented experiences that enable students to understand the relationship of school work to the world in which they live" (p. 1). Facilities must also be capable of evolving to support the learning activities of technologically driven curriculum revisions and expansions.

Instructors need to consider the possibility that the laboratory will have to be multi-purpose in nature — that it will need to be transformed from one type to another. For example, a lab may have to serve students during the day and accommodate community activities during the evening. The Industrial Technology/Technology Education facility of the future must be one in which change is not only possible but practical. In order to accomplish this, change must be planned into the facility design.

Instructors must always remember that ITE/TE facilities need to be versatile instructional settings and ***not*** simulated industrial facilities. Consequently these facilities must be able to respond to whatever setting the curriculum content and/or method demands. The students may be working on individual problems or research, working as a team on a problem, or participating in the process of mass production from product design to product distribution.

> **The industrial technology education facility of the future must be one where change is not only possible but practical. In order to accomplish this, change must be planned into the facility design.**

Missouri's leaders suggest that if the total estimated cost of modernization is over 30-40 percent of the estimated cost of new facilities then new facilities are cost effective. It is not practical to put money into a structure for which more money will have to be spent again in a few years. A primary question that should be asked is whether the facility, when updated, can house the required educational program. If the answer is "no" then the facility should be replaced. If new facilities are out of the question, old facilities may be updated to serve the objectives of the program. On the other hand, the old facilities may be so outdated that it becomes difficult to implement a program regardless of remodeling.

Numerous physical factors can affect and complicate the process of modernizing existing facilities. These include:

- Inconvenient placement of existing load-bearing walls or supports
- Outdated our inappropriately placed windows or doors
- Changing utility needs (e.g., plumbing for darkrooms, electrical needs for computers, etc)

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[1] The *MO ITE/TE Guide* development team appreciatively acknowledges Wisconsin's permission to cite and adapt their material as needed.

- The need to isolate "clean" and "dirty" spaces. Some existing laboratories may be directly connected to space which may be incompatible with the requirements of the updated laboratory.
- Temperature and humidity control needs. Many older facilities may require extensive and expensive alteration to accommodate the demands of the new technologies (e.g., air conditioning for laboratories containing computers).
- Shifting enrollment patterns. Increasing enrollments can tax the existing space. A key to the modernization process is to carefully study the projected future space needs.
- Safety codes may require extensive alteration of the existing space during renovation. A major problem in recent years has been the difficulties associated with the safe removal and disposal of asbestos.

4. Case Studies

Based on this important background information, this section will turn to some outstanding examples of renovations which have been accomplished in Missouri schools. You will notice that each case study situation is unique. Some are high schools while others were designed for the middle school level. The schools also differ in terms of size and approach to facility planning. Beyond the differences, at least two very important and common threads run through each:

- Prior to embarking on the process of facility change, the individual faculties did their homework on curriculum. They asked serious questions about their long-range educational goals and what it was that they should be teaching in the future.
- They designed their facility changes to meet the unique needs of their own situations. It is extremely important to remember that "one size (or style, solution, or arrangement) really cannot fit all" when it comes to facility renovation and change.

This section contains five complete case studies. Case Studies 1-4 are Missouri schools. In addition, a separate case study (Case Study #5) was developed out of input obtained from six different schools. Teachers from these small schools were asked to share some techniques for making facility (and equipment) changes on very limited budgets. Case Study #5 represents a combination of that input. Finally, Case Study #6, entitled Knocking Down the Walls to Set Up for Tech-Ed was previously published in *School Shop*. The Case Studies were:

CASE STUDY #1:	LIBERTY MIDDLE SCHOOL (Liberty, MO)
CASE STUDY #2:	SOUTH CALLAWAY MIDDLE SCHOOL (Mokane, MO)
CASE STUDY #3:	HICKMAN HIGH SCHOOL (Columbia, MO)
CASE STUDY #4:	FARMINGTON HIGH SCHOOL AND MIDDLE SCHOOL (Farmington, MO)
CASE STUDY #5:	SMALL SCHOOL RENOVATIONS - LIMITED BUDGET SITUATIONS (Hamilton, Eminence, Breckenridge, Leadwood, Monett, Smithville)
CASE STUDY #6:	KNOCKING DOWN THE WALLS (*School Shop* Magazine)

Each of these leaders is to be commended for his/her willingness to embark on the demanding and challenging task of facility change. Additionally, Missouri's ITE/TE profession is indebted to them for their willingness to share struggle with change and growth.

CASE STUDY #1
Liberty Middle School
(600 W. Kansas; Liberty, MO)

WHERE ARE THE HAMMERS AND NAILS? WHERE'S THE SAWDUST? SHOP WAS NEVER LIKE THIS WHEN I WAS IN SCHOOL!

The room hums with activity. People are working in groups of two or three at modular stations. Control panels flash digital readouts, robotic arms move with steady precision, and everywhere computer screens glow with words and images. This might be some high-tech research center—maybe a lab at IBM, GTE, or NASA. But it's not. It's the technology lab at Liberty Junior High School—an example of a state-of-the-art technology education facility.

When most folks remember their junior high "shop" class, they think of the bird house or the foot stool they made. When visitors tour the Liberty lab, they're in for a shock. Instead of bird houses and foot stools, they will find students working on electronics, aerospace, and future technology. These are exciting projects. They teach students about the technology that will affect society both today and in the future. Visitors may well say, "Shop was never like this when I was in school." But the teachers point out that technology is becoming more and more a part of everyday life. Today's students need to know more than how to build bird houses and foot stools.

CHANGE AT HOME BEGAN WITH A TRIP TO KANSAS.

In 1988 the industrial arts curriculum at Liberty Junior High was slated for revision. Teacher Ray J. Riley saw his chance. One afternoon, Ray went to his principal, Grundy Newton, to discuss the possibility of making some significant changes. Because of the upcoming curriculum revision, Grundy was very open to Ray's ideas. Ray had heard about a progressive and successful technology program at Pittsburg, Kansas from the state industrial technology supervisor, Steve Coffman. Ray suggested that he and Grundy visit Pittsburg. If a picture is worth a thousand words, then a trip to the Pittsburg Middle School was worth a million. There, Ray and Grundy witnessed technology education in action. They were impressed with the functional design of the Pittsburg technology lab. They especially noted the extent to which the facility accommodated the curriculum. Most of all, however, they were impressed with the positive impact the lab had on students. At every turn boys and girls were busy at hands-on tasks. There was little or no disruption or distraction. The students were learning. As they were leaving

> **Visitors may well say, "Shop was never like this when I was in school."**

the Pittsburg school, Grundy asked Ray his impressions of the program. Ray responded that "a program like that would put Liberty on the map."

Gathering the facts: you've got to do your homework

Upon returning to Liberty, Ray and Grundy told Steve Storeholder, another industrial arts teacher at Liberty, about their trip. Steve immediately sensed their excitement and was eager to get involved. The three men decided to present the board with a proposal for establishing industrial education at Liberty. Ray decided to return to Pittsburg to gather more facts.

Ray wanted to ask some more questions and take a few other instructors along to let them see the program for themselves. Though Ray had a "million questions," the Pittsburg instructors, Mike Needen and Max Lundquist, were very willing to provide him information.

Once back from this second trip, Steve and Ray began preparing the proposal. Ray made phone calls to book Reps. and vendors to get an idea of equipment and supply costs. Steve began the lab design and put together a list of materials needed for renovation. (Throughout this time, Ray made many calls to Pittsburg, Kansas to double check details with Mike Needen.) It took almost a month to complete all the designs, compile the materials lists, and get a fix on costs.

Once the costs were estimated, Ray showed them to Grundy and discussed ways of obtaining necessary funds. Ray and Grundy decided to propose that the curriculum revision be covered by funds originally set aside for that purpose. They decided to propose that materials and other costs related to renovation be covered by capital improvement money and ITE grants from MO DESE. Ray and Grundy put together a detailed proposal, one that included design plans, specific costs, and all other related information. Now they were ready to approach the school board.

> **Rather than hit the board with a great deal of information in a formal meeting, Steve and Ray decided to talk with board members individually.**

PRESENTING THE PROPOSAL TO THE BOARD: YOU HAVE TO COMMUNICATE EFFECTIVELY

Ray and Steve knew their plans depended on the support of the school board. They also knew that the board would have to have a great deal of information if their support were to be won. Their proposal would have to include all the facts and they would likely have to answer a great many questions. Rather than hit the board with a great deal of information in a formal meeting, Steve and Ray decided to talk with board members individually. In the weeks before the proposal, they arranged to meet with board members one-on-one. They showed each board member their plans for renovation and curriculum revision. They talked about costs and deadlines for completion. But most important, Steve and Ray were able to impress upon each board member the importance of technology education. They conveyed the importance of technological literacy as preparation for competing in a technology-oriented world. They also emphasized that technology education was not merely a fad. They showed board members that many other states were adopting such programs.

This one-on-one interaction with board members also gave an opportunity for quality question and answer time. Board members were able to ask questions in an informal atmosphere. Steve and Ray had the opportunity to give complete answers outside of the pressures of a formal meeting setting. The board members came away from their one on one interviews with an excellent understanding of what technology education was all about. And, of course, the school board is more apt to support a program that it understands.

One-on-one interaction with board members also gave an opportunity for quality question and answer time.

Because they were well prepared, Steve and Ray felt very much at ease during the actual board meeting. Though a few board members were still hesitant to give full approval to the program, the facts, figures, design plans, and a host of other information eventually persuaded them otherwise. Ray and Steve made sure their information boiled down to one basic message: "We can either keep the old industrial arts and teach students leisure time activities or we can implement technology education and thus prepare students to meet the future."

THE RENOVATION PROCESS: OBTAINING THE FUNDS IS ONLY THE BEGINNING OF THE JOB.

Once the board approved funds, it was time to begin the actual revision. The changes that Steve and Ray had proposed involved more work than two men could do alone. The school's maintenance crew did all of the demolition of the existing lab and put in the lowered ceiling. The carpet was laid by local contractors.

Ray and Steve attended a technology education workshop in Pittsburg during the summer. At the workshop, Steve and Ray asked many questions about the facility revision and curriculum development. They knew they wanted a modular, self-directed curriculum but were not sure if they could write one themselves. Ray decided to purchase a curriculum package from the Pittsburg Kansas Middle School. After some modifications, Ray and Steve found that the Pittsburg materials fit their own particular needs. With the general curriculum in place they were able to design and construct the needed modules.

Self-Directed Learning is the key to the Liberty Program

Ray and Steve believe that self-directed learning is the key component of the program. To a considerable degree, students are their own teachers. The instructor acts trouble spots. Steve says that, if students think a particular task is too hard, they will try to get the teacher to do it for them. This, according to Steve, is when the teacher must give them even more encouragement. Though students sometimes have to be guided through a project, more learning takes place when they accomplish a task on their own. Because they are encouraged to "do it themselves," students develop a sense of ownership in the program. The students, therefore, feel a greater sense of accomplishment when they complete a project.

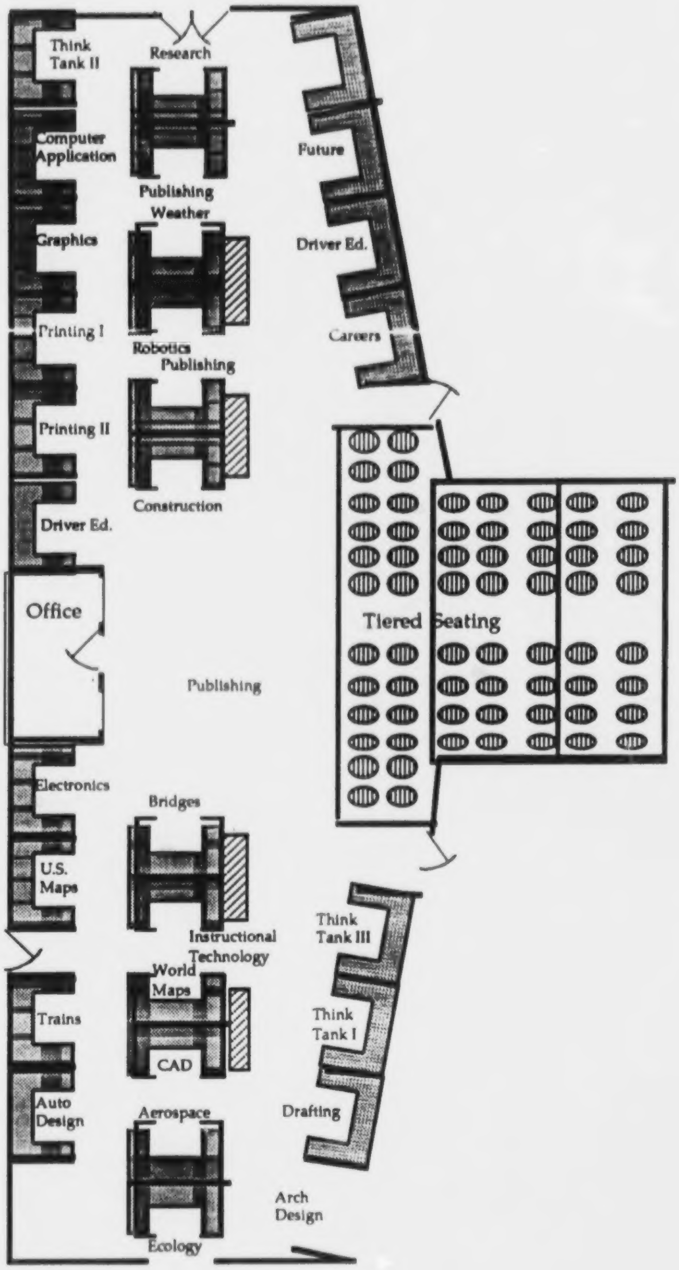
To a considerable degree, students are their own teachers. The instructor acts more like a coach, helping students through trouble spots.

EVERYBODY'S HAPPY (THOUGH MAYBE A LITTLE ENVIOUS)

Everybody's happy (though maybe a little envious)

Technology education at Liberty has been an absolute success. Students are enthusiastic. Parents think the change is great. The administration and school board support the program completely. Perhaps the only "problem" Ray and Steve have met with is a touch of good-natured envy from other teachers. Several of them would like to teach in an exciting and unrestricted learning environment like the technology lab. Being the object of a little envy, however, is something Steve and Ray think they can live with.

Figure III-3
Liberty Middle School


Think Tank II
Research
Computer Application
Publishing
Future
Weather
Graphics
Driver Ed.
Printing I
Robotics
Publishing
Careers
Printing II
Construction
Driver Ed.
Office
Tiered Seating
Publishing
Electronics
Bridges
U.S. Maps
Instructional Technology
Think Tank III
World Maps
Trains
Think Tank I
CAD
Auto Design
Aerospace
Drafting
Arch Design
Ecology

CASE STUDY #2

South Callaway Middle School

(P.O. Box 37; Mokane, MO)

THE "KINGDOM OF CALLAWAY" IS A HAVEN FOR HIGH TECH

People interested in trivia about Missouri can tell you that the town of Mokane is located in Callaway County—a county that officially calls itself the "Kingdom of Callaway."

What Missouri trivia buffs may not know is that Mokane is not only a part of a Kingdom; it is also a haven for a state-of-the-art technology education program located in Mokane's South Callaway Middle School.

Visitors to South Callaway's technology education lab immediately know they are in a place of excitement and learning. A group of clean, brightly colored modules is placed symmetrically about the room. Running down the middle of the lab is a row of three Y-shaped work stations. Everywhere students are busy working with anything from interfaced robotic systems to bio-technology. The South Callaway Middle School technology program is an educational effort that can boast absolute success—something all too rare these days.

SUCCESS BEGINS WITH RESEARCH

As Herb Kuschel, the technology teacher at South Callaway Middle School will tell you, getting a technology program started requires much research. Long before the program became a reality, Herb carefully considered what changes had to be made. Talking with suppliers of educational materials and his colleagues around the state gave him an idea of the equipment and materials available.

When choosing a curriculum, he had a specific set of criteria in mind. The curriculum had to be appropriate for his students. Reading level was of particular concern. The material also had to accommodate both the less-gifted student as well as the budding genius while remaining interesting and exciting to everyone.

Talking with suppliers of educational materials and his colleagues around the state gave him an idea of the equipment and materials available.

Another important factor was the amount of time required for implementation of the curriculum and its flexibility. Herb did not want materials that would require a tremendous amount of set-up and preparation time. As different needs arose, he wanted to be able to make changes in any part of the program as quickly as possible.

Cost and space availability were also important considerations. Herb had one additional requirement, which was perhaps the most important. He had to believe in what the curriculum taught and how it taught it. Any curriculum that failed to give students genuinely valuable experience with technology was worthless—no matter how inexpensive or easy to implement it might be.

After much research, Herb decided that the Classroom 2000 system by Trans Tech would best serve his needs. The Classroom 2000 package includes a basic curriculum that can be modified to fit a variety of instructional situations. This flexibility was a welcome feature in light of space and budget limitations. A curriculum package gives the instructor confidence. Developing a technology program is to some extent a journey into uncharted waters. The teacher may ask him or herself "Am I really ready to be a true teacher of technology?" The right curriculum can help ease these fears.

WRITING THE PROPOSAL: BLOOD, SWEAT, AND DETAILS

With most of the research completed, it was time to write a proposal which included the following: a thorough and convincing justification for implementing the new program; a detailed description of necessary facility renovations; and finally, a tentative budget with carefully estimated costs.

Writing the proposal was a tough job. Herb began by doing a free writing (which involved putting down all the information he could in an unstructured manner). The next step was to organize and further develop the free writing. After several revisions, a usable draft began to emerge.

At the board meeting, Herb was not only ready with copies of his proposal, but he also had a three-dimensional foam model of how the proposed facility would look. In addition, he also showed the board a video, emphasizing the importance of technology education. "Seeing is believing," held true at the board meeting.

At the board meeting, Herb was not only ready with copies of his proposal, but he also had a three-dimensional foam model of how the proposed facility would look.

Common sense suggests that people are more apt to accept a new idea or concept if they understand it. Therefore, several weeks before the school board meeting, Herb sent school board members literature (primarily journal articles) about technology education. This allowed board members time to get acquainted with the idea.

DOING AS MUCH AS YOU CAN YOURSELF: A WAY TO CUT COSTS

After the board approved the funding, it was time for the work to begin. Extensive clean-up of the existing facility began during the actual school year. The actual construction and remodeling did not start until the summer. Rather than contracting out the demolition work, school maintenance people did the job. This was cheaper and probably more efficient. The school hired local contractors to construct block walls, set windows, and lay carpeting. Herb did all other work himself. He also recruited student help, which not only saved money but provided good experience for all students involved. Creativity in procuring help along with the use of handyman abilities of students and school personnel saved the project much money.

FOR PROOF OF SUCCESS, JUST LOOK AT THE STUDENTS

On any given day at the South Callaway Middle School technology lab, you will find students working intently on a variety of different tasks.

Despite the variety of activities, the lab maintains an atmosphere of order and purpose. Students are genuinely interested in what they are doing. Very seldom will you find a student doing an assignment with a "do-I-have-to?" attitude.

Student's enthusiasm for technology education has not escaped the notice of teachers, parents, and administrators.

Of course, Herb's teaching ability has much to do with the success of the program. However, the careful design of the facility has a tremendous impact.

Students' enthusiasm for technology education has not escaped the notice of teachers, parents, and administrators. The lab at South Callaway Middle School proves that "nothing succeeds like success."

A FEW WORDS OF WISDOM

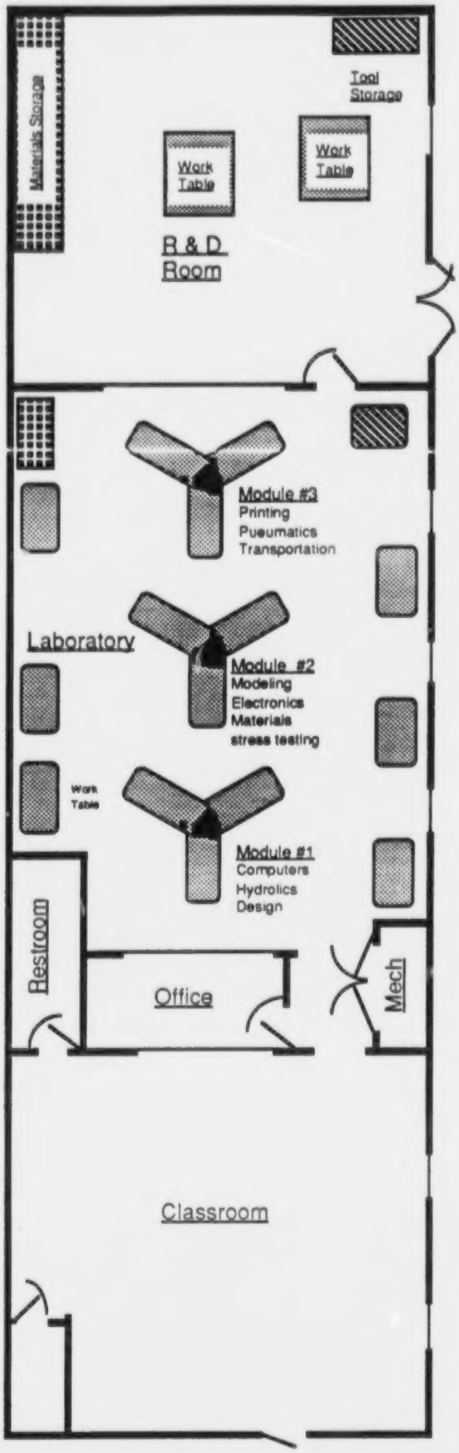
Looking back on it all, Herb emphasizes that detailed planning is the key to success. In addition, the ability to communicate these plans to anybody and everybody is of primary importance. The best ideas in the world do you no good if you can't tell others about them. Herb advises to have both a clear general picture of your program and as many details as possible on the tip of your tongue.

When the actual modifications begin, Herb suggests teachers be as creative as possible in obtaining materials and equipment. One person's junk can be a technology teacher's gold. In other words, there is no shame in scrounging for the cause of education.

For example, the walls of the technology lab are covered with salvaged redwood siding and the drop ceiling is filled in with discontinued tiles. They don't all match, but, of course, nobody complains.

Finally Herb advises teachers and administrators to be ambitious but realistic. Trying to do too much can be as counterproductive as trying to do too little.

Figure III-4
South Callaway Middle School


Materials Storage
Tool Storage
Work Table
Work Table
R & D Room
Module #3
Printing
Pueumatics
Transportation
Laboratory
Module #2
Modeling
Electronics
Materials
stress testing
Work Table
Module #1
Computers
Hydrolics
Design
Restroom
Office
Mech
Classroom

CASE STUDY #3

David H. Hickman High School

(1104 N. Providence Rd.; Columbia, MO)

AT HICKMAN HIGH SCHOOL, TECHNOLOGY LAB, FLEXIBILITY MEANS THE FREEDOM TO LEARN

All rooms in the Hickman lab are bright, clean, and spacious. Equipment in the power and energy room (table saw, drill press, belt sander, and miter saw) is scaled down, allowing for more space. There is also plenty of space in the communication labs, where eight network Mac Classics sit on a full-length wall counter. In the technology system classroom, work stations are placed around the perimeter, leaving the middle of the room open. All tables and cabinets in the center of the lab are portable. The extra space and portable equipment mean flexibility, which in turn means convenience. But it also means the freedom to modify student's projects, lesson plans, and equipment easily. And all of this means the freedom to learn.

> **The more flexible your facility the more possibilities you will have with your curriculum.**

With the new curriculum and the potential for constant change, flexibility is extremely important. The more flexible your facility, the more possibilities you will have with your curriculum.

SOME SMALL MODIFICATIONS LED TO SOME BIG RESULTS

Ben Yates and Tim Trogdon must believe that action speaks louder than words. Before approaching the administration or school board with big plans for change, the two teachers scrounged up some old science lab tables, painted the walls of an existing classroom, and converted it to a modular system. With these few inexpensive changes, Ben and Tim created a new and exciting atmosphere for teaching technology. In these early days they may have lacked sophisticated equipment and detailed curriculum, but they had something just as important. They had a start, a foundation upon which to build the kind of facility they wanted.

The class, Industrial Technology, now called Technology Systems was begun after receiving a grant from MO DESE's Industrial Technology Education Grant Awards Program. Ben and Tim developed their own curriculum from one set of text books and several reference books. Once the class was initiated and the students showed an increased interest and success, they began to look at the overall program. Soon, word traveled, and, after seeing the enthusiasm in the new class, the principal began to suggest that the rest of the curriculum be changed.

As the new curriculum developed, the team constantly fed the administration articles to help prime them for the change. With a new curriculum in the works, Ben wrote a proposal and sent copies to the superintendents of the district. The team then invited the superintendents to meet with the team, tour the facilities, and discuss the proposal. At this point communication skills became very important. As Ben states, "You can't do anything without rapport; you have to have people skills. It's politics." The meeting sold the administration on the proposal. The administration even offered to present it to the school board (though Ben did attend the meeting to help answer questions).

THE NEW FACILITY NOT ONLY ENCOURAGES LEARNING, BUT BUILDS SELF-ESTEEM

Tim notes that "students feel very good about the environment they're working in...psychologically. It shows them that somebody cares." Students often opt to work on the lab's computers during study hall and after school. Outside of class, students can be overheard talking about "what's happening in their technology class." The new curriculum and facility revision have provided a great amount of stimuli for the students.

> **The facility should not only be functional but it must look nice.**

STUDENTS ARE NOT THE ONLY ONES CAUGHT UP IN THE CHANGE

At first some teachers from other subject areas had mixed feelings about the new lab. They found it a little difficult to understand why so much money and effort should go into one project. Once the changes were in place, however, the other teachers realized the program's value. Many of the teachers have even been inspired to seek out innovations for their own programs.

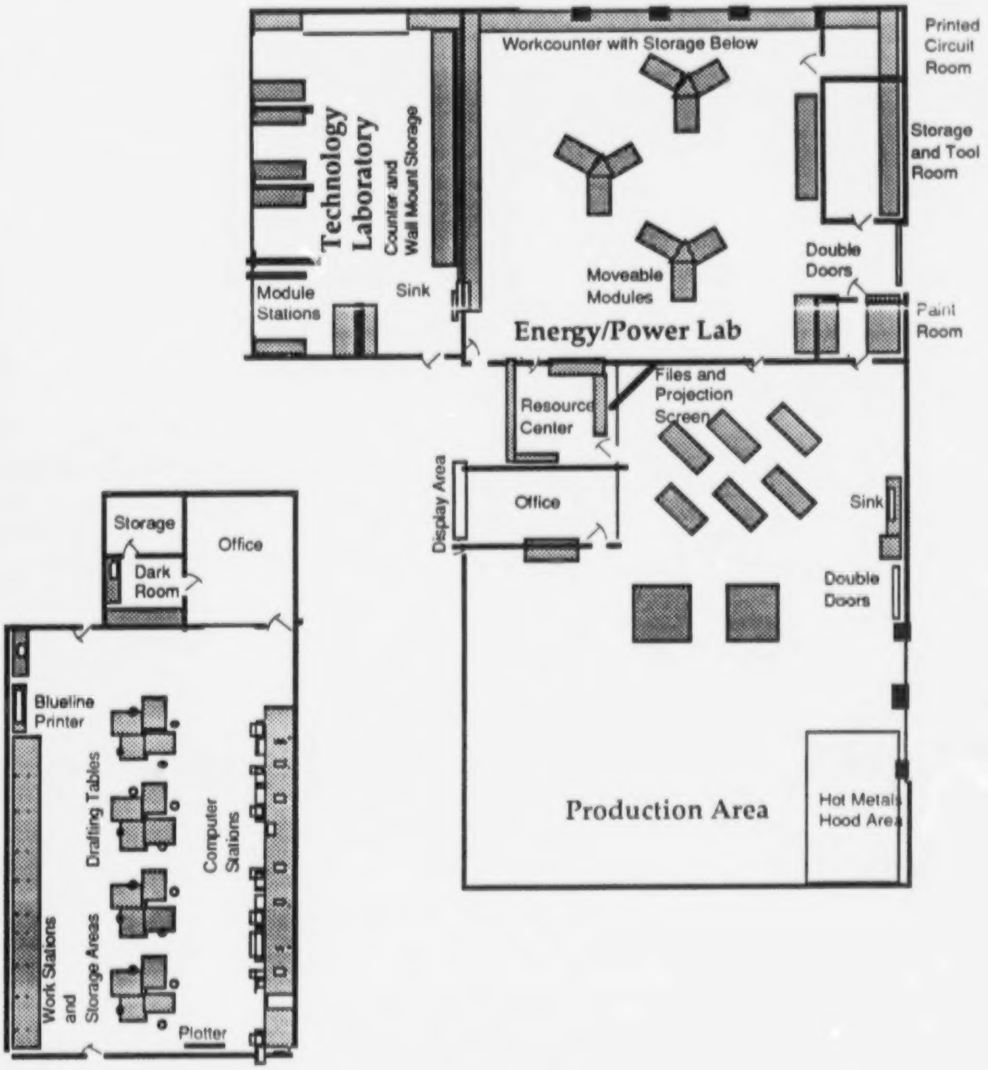
YOU JUST CAN'T PLAN ENOUGH

Ben and Tim's basic words of wisdom for facility revision are "plan, plan, and then plan some more." Developing a technology education facility is costly both financially and in terms of human energy. Few if any school districts can afford to waste time and money. Planning at all stages of development helps to ensure efficient realization of goals.

Ben and Tim also emphasize the importance on aesthetics. The facility should not only be functional but it must look nice. It must be a place where students will want to learn. The psychological benefits are well worth the effort.

Ben and Tim also emphasize the importance of including everyone who will be affected by the program. When people are asked for their ideas or input they develop a sense of ownership in a project. This insures future support. Above all, Ben and Tim emphasize the importance of building flexibility into the facility. As they note, technology changes rapidly and you have to be ready to change with it.

Figure III-5
Hickman High School


Printed Circuit Room
Workcounter with Storage Below
Technology Laboratory
Counter and Wall Mount Storage
Storage and Tool Room
Double Doors
Moveable Modules
Module Stations
Sink
Energy/Power Lab
Paint Room
Files and Projection Screen
Resource Center
Display Area
Office
Sink
Double Doors
Storage
Office
Dark Room
Blueline Printer
Drafting Tables
Computer Stations
Work Stations and Storage Areas
Plotter
Production Area
Hot Metals Hood Area

CASE STUDY #4

Farmington High School

(Farmington, MO)

TECHNOLOGY EDUCATION IN FARMINGTON: HIGH-TECH IN A SMALL TOWN

In the small town of Farmington, life moves at a comfortable pace. The people you meet are friendly. At almost every turn you get a dose of genuine rural hospitality. However, when it comes to technology education, don't think Farmington is in the slow lane. One visit to Farmington's middle school and high school technology labs will prove you wrong.

FARMINGTON'S SUPERINTENDENT: A MAN WITH A VISION

At Farmington, it was the superintendent, Dr. Webb, who first called for the change from industrial education to industrial technology education. Dr. Webb discovered technology education through an article on the Pittsburg, Kansas program. After becoming familiar with technology education and its potential for enriching the school curriculum, Dr. Webb met with the principals and teachers at both the middle school and high school to develop a plan for implementing technology education programs. Bill Bratberg and Don Francis, the high school technology teacher, and Bruce Slinkard, the middle school technology teacher were, of course, excited about the prospect of change. Deciding to work together, the superintendent, principals, and teachers visited and consulted other school systems that developed successful programs (e.g., school systems in Liberty, Columbia, and Mokane, as well as Pittsburg , Kansas). The group inquired about the cost of equipment and facility revisions, and the amount of time required for revisions. They also obtained any other information that would make the transition easier.

To underscore the legitimacy and significance of their proposal, the group showed the board a video highlighting the content and objectives of technology education.

Once the essential information was assembled, the superintendent prepared a written proposal, which included estimated costs of the needed revisions and equipment, and a thorough set of design plans for both the high school and middle school labs. The superintendent, the principals, and teachers all participated in presenting the proposal to the school board. To underscore the legitimacy and significance of their proposal, the group showed the board a video highlighting the content and objectives of technology education. Because of the superintendents belief in the program, the board supported the his belief and approved the proposal.

Once the funds were approved, the district maintenance department began tearing out portions of the old middle school facility. (The high school facility would be housed in a vacant room and, therefore, no tear down was required.) Because the tear down began during the school year, the maintenance crews began work at the middle school immediately after school and continued into the evening. The actual construction at both schools did not begin until summer. Each evening when the work was done, the facilities had to be cleaned up and prepared for classes the next day. Bruce said that it worked out rather well because the students were working out in the lab during this phase of the project.

Making use of teacher and student help not only reduced cost but also provided additional learning opportunities.

Bruce designed the modules for both the middle school and high school labs. The high school carpentry class did the actual construction and then Bruce was hired by the district during the summer to put in the modules and work on the curriculum. At the high school, the construction class not only built the modules but they also installed them. Mr. Bratberg was was also hired during the summer to set up and network the computers and develop his curriculum.

Making use of teacher and student help not only reduced cost but also provided additional learning opportunities. All stages of the project reflected a sense of cohesion among students, teachers, and administrators. As middle school principal Jack Richardson remarked that effort represented "an excellent commitment from the administrative staff and district."

YOU CAN STILL HAVE THE BEST OF BOTH WORLDS

Upon first entering the Farmington Middle School lab, one notes how modules (which are equipped with state-of-the-art instructional equipment) are positioned around a more traditional work area (which is equipped with a table saw, band saw and hand tools). This arrangement reflects Mr. Slinkard's desire to instill in students some traditional hands-on skills. Mr. Slinkard feels that the 6th grade class should receive instruction in the traditional basics. In addition to being functional, this arrangement serves to illustrate the progression from traditional industrial arts to the latest innovations in technology education. The lab, therefore, allows students a smooth transition from working with familiar shop equipment to interacting with new and innovative technology. This comfortable combination of old and new serves as an interesting example of change. The nice thing about this space is that it allows for future flexibility.

WHAT? ALL ACTIVITIES ARE TAUGHT EVERY CLASS PERIOD?

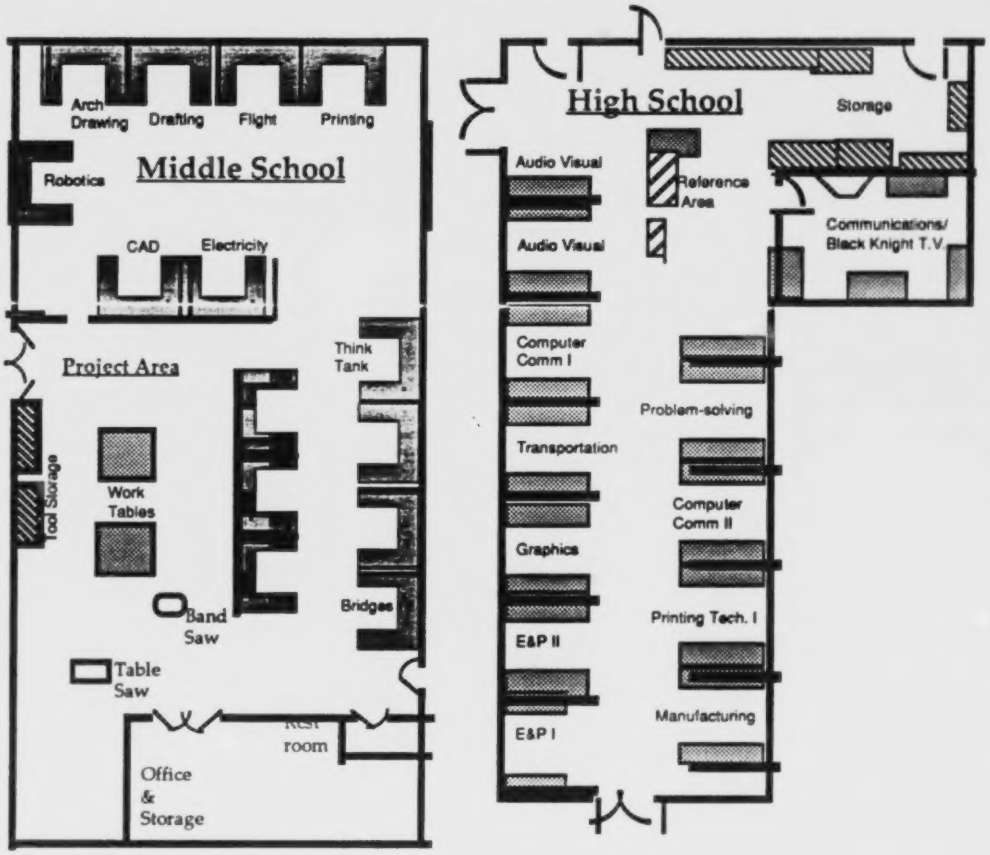
You want flexibility, they've got it. Because Bill Bratberg's high school program is modular and self directed, he has the flexibility to offer all technology classes every period. It also has the advantage of being interdisciplinary. Students may come from a music theory class to do a unit on the Musical Instrument Digital Interface (MIDI). Art students come to use graphics programs to do art projects. In a joint venture with the journalism class, students are putting together a school news production. Bill says that there are some bugs arise as a result of offering every class each period but it's workable.

The nice thing about this space is that it allows for future flexibility.

Bill suggests that when thinking about equipment needs, don't forget about wiring in for networks and be sure to put them on a separate circuit. That may sound crazy, but in a technology lab with other equipment running there is a possibility of an overload on a circuit. That means you would lose everything that students were working on at the time. Along with that, build into your overall budget a repair and maintenance budget for your computers. They are expensive to repair.

Figure III-6

Farmington Middle & High School


Arch Drawing
Drafting
Flight
Printing
Robotics
Middle School
CAD
Electricity
Project Area
Think Tank
Tool Storage
Work Tables
Band Saw
Bridges
Table Saw
Rest room
Office & Storage
High School
Storage
Audio Visual
Reference Area
Audio Visual
Communications/ Black Knight T.V.
Computer Comm I
Problem-solving
Transportation
Computer Comm II
Graphics
Printing Tech. I
E&P II
Manufacturing
E&P I

CASE STUDY #5

Small School Renovations - Limited Budget Situations

(Hamilton, Eminence, Breckenridge, Leadwood, Monett, Smithville)

RENOVATION - YES IT CAN BE DONE ON A BUDGET

You may be thinking, "My school can't afford to shell out thousands of dollars for my program." This may be so on a large scale but it can be done on a small scale. Every teacher I talked with said that the first step is to make a commitment to technology. This means time and effort. You have to believe in the change or it will not work. Listed below are inexpensive changes that can be done to help present a new image:

- Clean up the classroom and laboratory areas: This takes no money and you will be surprised how many people will notice.
- Paint walls, cabinets and equipment: Every district has paint stored away. Chum up to your custodian. He will know where and how to get it.
- Rearrange the furniture: This seems simple but it can improve formal instruction. Students will have lots of questions about the change. Check out their attitude.
- Create a new display area and bulletin board: Students love to see their work on display. The bulletin board can be done by students. Give them a theme and let them be creative.

These are some very basic things that you can do, without money, to show students, teachers, and administrators that you're on the move.

Don't worry about mistakes or that it didn't work. That is all part of the technological process.

JUST DO IT

Get your students involved with some low-cost activities. Some great ways to obtain activities is through workshops, conferences, and looking through the Missouri Technology Guides. Also try textbook vendors. They will have textbooks and activity manuals that you can preview for free. These first activities should meet three criteria:

- Fun
- Hands-on
- There should be an objective that is to be met.

The whole idea here is to get the students hooked. Don't worry about mistakes or that it didn't work. That is all part of the technological process. If the students say they like it, have them talk to others about it. Try to have the principal observe the interaction and activity.

SCROUNGE EVERYTHING YOU CAN

You never know what you might get unless you ask. Go to hardware stores, lumber yards, cabinet shops, and local industry. Tell them that you're from the school and what you are doing. You may get more than you bargained for.

Several teachers have made darkrooms with a little bit of nothing. One teacher sealed off the end of a small storage space with 2" x 4" construction and sheet rock and ran the new plumbing from the existing plumbing on the other side of the wall. The sink came from an old bathroom. Another teacher closed in the space of his existing sink with two walls making a 6'x 6' darkroom. He got his cabinets free from a lumberyard because they were damaged and his counter top was two pieces of scrap. One teacher even went modular by using old art tables with bookshelves and bathroom stalls as dividers. The key he says is to take little bites, it is easier to chew.

BUT WHAT ABOUT GETTING EQUIPMENT? WHERE THERE'S A WILL THERE'S A WAY

There is one common theme for every teacher in this case study. In order to get the equipment you want, you have to receive grant money. This is where dedication can pay dividends. It's an awful lot of work but it has been the only way any substantial amount of money has been funded to purchase major equipment. To make it a little easier, contact the supervisor of Industrial Technology Education to get a list of names of people who you could contact to answer your questions about writing for the Grant Awards Program.

Another way to fund small or portable equipment is through fund raisers. Again it's a lot of work but it gets the students involved in the program and they will take more pride in it.

BE REALISTIC

All of these teachers have been rebuilding their programs for at least three years and they all basically say the same thing; it takes time and it does take money, but there are ways to reduce the dollar amount. Be prepared to do all the work yourself; that is the only way it will get done. If you take it one piece at a time and continue to build year to year, the pieces will come together. The key is that you have to believe in your program and be willing to make some sacrifices to make it work.

CASE STUDY #6

Knocking Down The Walls

(School Shop)

Under industrial arts, we had nice, neat little spaces for each course. Metals instruction took place in the metals shop, woodworking in its space, graphics in its area and so on, even down to finishing in the finishing room. Conversely, technology by its very nature calls for a blending or overlapping of these traditionally separate areas. To show a continuance of processes in the production of goods or the interrelationship of skills, machines and resources, you should have an open laboratory.

Different areas of the technology laboratory must retain their own special characteristics, such as electricity/electronics or transportation, but the entire facility must show enough flexibility to accommodate use as needed by other technology content areas. While in theory this may not be that hard to accomplish, a major drawback rests with the concepts that we have inherited from industrial arts, where each shop has stood by itself. These concepts go back to days when we were comfortable and when space, curriculum and financial restrictions figured in less than they do today.

> **The entire facility must show enough flexibility to accommodate use as needed by other technology content areas.**

GET THE BIG PICTURE

To survive effectively with new programs, we must be able to consolidate space and create new open arrangements so that our students can see the big picture and so that processes can flow easily from one course section to another.

FOLD IT UP AND PUT IT AWAY

As depicted in Figure III-7, the central area of the laboratory forms the lecture/information area. A teaching bench, which doubles as the teacher's desk, stands in front of 16 folding desk chairs. Behind the teaching bench, blackboard space and the areas on either side of the blackboard provide an information center with books, planning materials, magazines and other resources. If the folding chairs are not needed during laboratory production, they can be removed for extra floor space.

GO TRIANGULAR

The rest of the facility is designed around this central area. Each individual area forms a large triangle in which equipment is placed, with one point reaching to the lecture/information area. This format keeps student movement to a minimum. For example, with the students working on an electronics project, lessons and planning take place in the lecture/information area, laboratory work on component assembly occurs in the electricity/electronics area and construction work on the printed circuit and case for the project takes place in the end of the metalworking area closest to the electricity/electronics area. The students are thereby confined to an organized section of the laboratory that suits their current project.

The overriding key is that enough variety in equipment has been located in each area so that students' talents can be maintained consistently under the integrated notion of technology education.

Another example of such triangulation of activities lies between the lecture/information center and the metalworking area. The concept of production unfolds in the move from metal cutting to fabrication, to assembly and finally, to finishing.

Conversely, all areas can combine in the study of such broad concepts as transportation. Work on small engines takes place on a bench with engines secured to it on metal stands. After completing small engine work, a student can move to model working on an electric car – the engines are stored and the student benches then serve as a site for fabrication processes.

EASY ACCESS DOESN'T MEAN EASY ENTRY

While the lecture area makes a natural teaching center, the wood benches or the electricity/electronics benches can also be used for such purposes, since each area has a blackboard. Tool panels are located on the walls in each area and floor tool cabinets serve locations without walls.

Materials and equipment are stored in each laboratory area where students can have easy access—when materials are needed they are at hand. Equipment requiring ventilation goes at one end of the laboratory to facilitate the construction of a ventilation system. Electrical connections are made by ceiling drops to benches and equipment.

A computer should be located in the lecture/information center. However, the computer-assisted drafting/design system, along with the administrative computer area, should be located in the technical drawing section, next to and accessible from the laboratory. Such equipment is sensitive and requires a clean area.

The equipment included in this floor plan can provide a multitude of student laboratory experiences in technology education. Areas are generally flexible enough to permit use in processing a wide variety of materials. The overriding key is that enough variety in equipment has been located in each area so that students' talents can be maintained consistently under the integrated notion of technology education. Obviously, instructors can make additions or variations to suit their special needs.

POINTS TO PONDER

The important lessons that can be learned from this kind of a case study include:

- The facility must serve the students, since their education is always the prime concern.

Your technology education program or course of study must be up to date. You cannot plan for future facilities with an old industrial-arts-style program.

- A good computer-assisted drafting/design system is critical for the future of technical drawing. We have five stations, each involving a state-of-the-art computer with state-of-the-art CAD software.
- Association with other curriculum areas can strengthen our technology education program and also help save other curricula which may be in danger. This will form a solid occupational center, capable of attracting students to our main building.
- You must let people know your ideas and opinions concerning proper facility planning. Do this without delay. If you do not present your concepts for change, no change will take place. The speed at which educational redesign can occur is phenomenal.
- Your technology education program or course of study must be up to date. You cannot plan for future facilities with an old industrial-arts-style program.
- Stress safety in all planning activities. Safety is always a concern and the more you address it in your planning the safer your overall facility will be.
- Don't consider the removal of walls a great obstacle. Educators tend to think of taking out a wall as a drastic procedure, but remodeling contractors can easily plan and execute such removals. The increased safety and efficiency is well worth the effort.

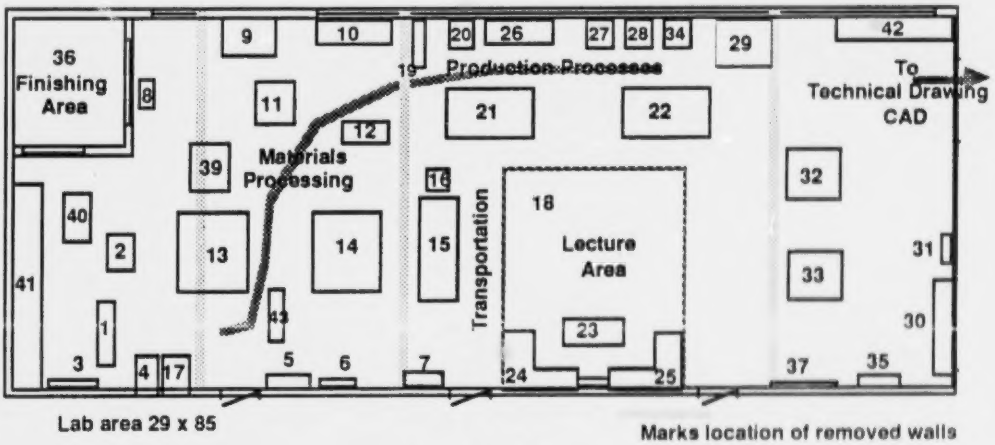
The primary lesson learned from all of this is the importance of teacher planning. The teacher's input concerning requirements for a good facility must be made clear to all parties — particularly to the administrative folks who regulate facility changes. Write everything out and submit it as quickly as possible. The total elapsed time for our initial planning was 11 weeks from the time I was first told that changes would be needed to the point when the school officials accepted our facility-change proposals.

In that period, floor plans were made and remade, alternatives discussed, equipment lists and potential suppliers developed, studies made on CAD systems and the necessary wall removals and other facility changes detailed. I presented in writing all necessary information so that the administration could study and understand the kind of facility that we needed and how it would best serve the students in our technology education program.

(Reprinted by permission of Prakken Publication, pp. 45-47, School Shop, April 1986).

Figure III-7

Renovated ITE Laboratory


36
Finishing Area
8
9
10
19
20
26
27
28
34
29
42
Production Processes
To Technical Drawing CAD
11
12
21
22
39
Materials Processing
16
18
Lecture Area
Transportation
40
2
13
14
15
32
33
31
41
1
43
30
23
3
4
17
5
6
7
24
25
37
35
Lab area 29 x 85
Marks location of removed walls

Design Considerations

1. The area will accommodate an average-size class of 16 students.
2. The area will allow for a total view of the facility by the instructor.
3. The area will provide lecture area and laboratory area sufficient to provide a basic three-unit sequence of TE.
4. The area will provide for interaction between its individual facility areas.
5. The area will be adaptable to accommodate change and program revision.
6. The individual laboratory facility areas of woodworking, metalworking, transportation and electricity/electronics will be designed around a triangular structure. Individual pieces of equipment and the lecture area will form a triangular area for ease of movement by the students and instructor.
7. Within the individual facility areas, machinery and laboratory equipment will be arranged to provide for ease of material flow during production operations.
8. Written material will be easily accessible to students as will computer utilization for drawing and planning.

Legend

1. Wood lathe
2. Band saw
3. Wall tool panel
4. Jigsaw
5. Sink
6. Wall tool panel
7. Blackboard
8. Belt sander
9. Welding area bench, tanks, and arc welder
10. Metal soldering table with furnace
11. Table saw
12. Jointer
13. Wood bench with lockers
14. Wood bench with lockers
15. Small engine bench with lockers
16. Tool chest
17. Wood drill press
18. Lecture area
19. Spot welder
20. Grinder
21. Metal bench with lockers with roll form
22. Metal bench with storage with brake and shears
23. Teacher lecture bench
24. Bookcase/information area
25. Bookcase/information area
26. Metal lathe
27. Metal drill press
28. Tool cabinet
29. Squaring shears
30. Bench with lockers
31. Sink
32. Electrical bench with lockers
33. Electrical bench with equipment storage
34. Metal tool and hardware cabinet
35. Wall tool panel
36. Finishing area
37. Blackboard/bulletin board
38. Blackboard/overhead
39. screen
40. Surface planer
41. Radial arm saw
42. Wood supply rack
43. Metal supply rack
44. Wood rack -- shorts

5. Additional Issues/Techniques

Additional Cost Saving Tips

There are at least two very different approaches which can be taken in facility renovation and module construction.

Approach #1: The first is one that ITE/TE teachers tend to use by instinct; that is, to do the job themselves with whatever materials can be scavenged, donated, or borrowed. The approach is often very necessary given the financial constraints which are always present in the schools. This section will present some tips for making changes on a limited budget.

Approach #2: Most ITE/TE teachers are not as comfortable (or experienced) with the second approach. This approach is to present a thoughtful and convincing proposal to the administration for funding. Even a brief glance across the curricular and extracurricular activities of the schools will reveal that significant dollars are invested annually for programs that are valued in the community. This has important implications for ITE/TE programs. When good things are happening in the programs; when ITE/TE teachers carry themselves with confidence and excellence; when proposals are submitted that show sound educational thinking and connection with the pulse of the future; then administrators will consider directing significant amounts of money to make it happen. It is critical that ITE/TE teachers develop and demonstrate the kinds of "people skills" that it takes to package and promote solid educational change. This is perhaps more important than at any other point in the proud history of our profession.

> **It is critical that ITE teachers develop and demonstrate the kinds of "people skills" that it takes to package and promote solid educational change. This is perhaps more important than at any other point in the proud history of our profession.**

In spite of funding which can be obtained to update facilities and equipment for ITE/TE laboratories, much of the change will still need to happen on a tight budget. Some suggestions (in addition to Case Study #5) for making progress on a limited budget include:

- Writing a proposal for the MO DESE ITE Grant Awards program
- Submitting requests to suppliers and vendors for donations of materials, supplies, or equipment
- Working with vendors who are willing to place equipment in your facility on a loan basis
- Engaging a student club or student workers in the construction process (furniture or module items)

- Keeping an eye on the materials that regularly flow through the various salvage agencies
- Doing some of the work yourself
- Cleaning up and painting. Many times, some extensive cleaning and fresh paint can make a major difference in the appearance of a facility with very little financial investment
- Develop a TSA-sponsored, fund-raising effort
- Consult with other teachers who have been through renovation
- Make changes in planned stages over several years
- Use salvaged materials
- Employ the "barter" system

Space Management

One important branch of industrial design is ergonomics. Essentially, this has to do with the important variables that affect the ways in which people interact with their environments. This includes many design factors, such as the proper heights of chairs and work surfaces. Recommendations are also made for the design of instrumentation and control devices (e.g., gauges, control levers, handles, etc.). In the process of designing Industrial Technology/Technology Education space, it is critical that these important dimensions be researched and considered.

One important aspect of ergonomics is overall space management design and coordination. Essentially, space management is the process of identifying and then managing ***all of the human and physical variables*** that affect the physical facility. Among the important considerations are the following:

- Reviewing and projecting student traffic flow patterns
- Assessing the "per student" space needs for the type of activity which will be conducted in the space
- Time frames within which students will be using the various spaces
- Choosing space configurations that promote "on task" learning (the paired student module approach is a current example of a controlled environment which facilitates student concentration)
- Designing aesthetic factors to promote learning positive attitudes (e.g., lighting, color schemes, seating configurations, etc.)
- Developing a physical environment in which the selected curriculum can be effectively delivered
- Conducting an inventory of all available space in order to identify primary and alternate uses
- Assess the existing space configuration for ways to make it more flexible

6. Laboratory Concepts

Curriculum change which in Industrial Technology/Technology Education has contributed some creative and innovative new laboratory configurations. Figures III-8 through 11 depict some of the possible options. (The MO ITE/TE Guide Revision team wishes to acknowledge Pamela Hulen for her work in producing these drawings.)

- **Figure III-8:** Carrel Concept

  The carrel concept consists of a series of spaces which are typically arranged along a wall or walls. The distinguishing feature of the carrel concept is that it can be arranged in multiple configurations (cross, Y, U are the most common). The carrel is distinguished from the module concept where the module does not provide a visual barrier between spaces.

- **Figure III-9:** Alcove Concept

  The alcove concept consists of a series of dedicated room-like spaces (alcoves) arranged around the perimeter and/or center of a room. The distinguishing feature is that it is enclosed space (both spatially and visually).

- **Figure III-10:** Module Concept (perimeter arrangement)

  The module concept has become quite popular in recent years. Modules, which are typically designed to accommodate two students, can be arranged in a variety of ways. The distinguishing characteristic is that they do not include a visual barrier between modules. Figure III-10 depicts a perimeter arrangement.

- **Figure III-11:** Simple Module Configured from Tables

  Figure III-11 depicts an example of a centrally located module which could be constructed with typical classroom tables and some inexpensive center-core materials. Certainly, modules can range from elaborate to simple and functional. This concept consists of a large area with learning space arranged to support individual modules or learning activities. It often includes an area for classroom/theater instruction.

Figure III-8

Carrel Concept

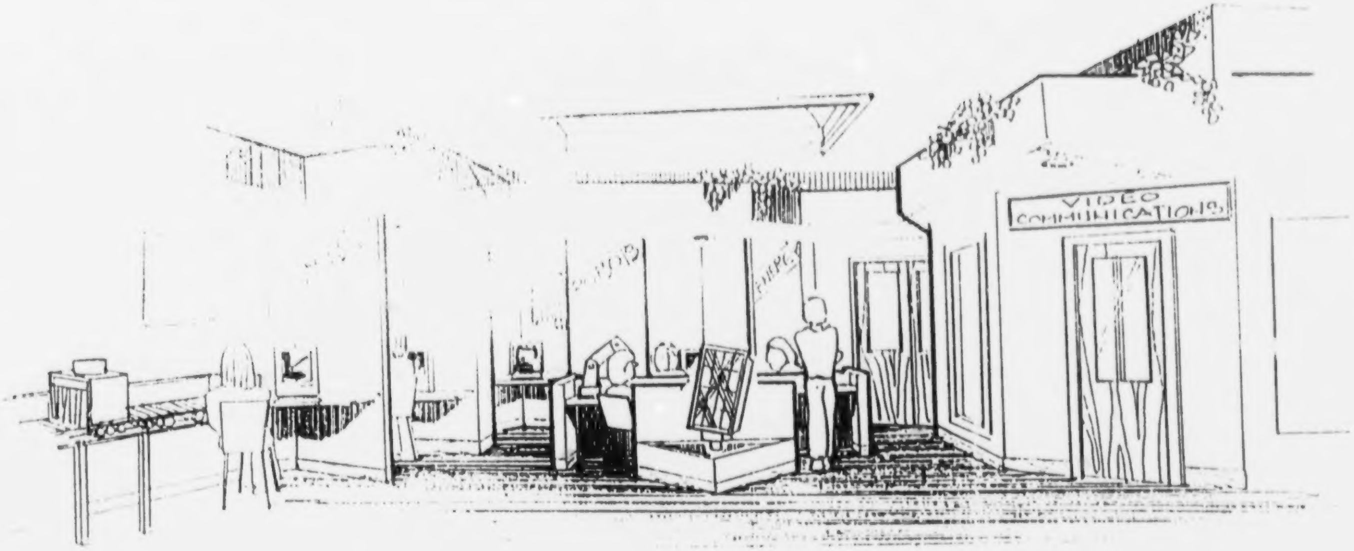

VIDEO COMMUNICATIONS

Figure III-9

Alcove Concept

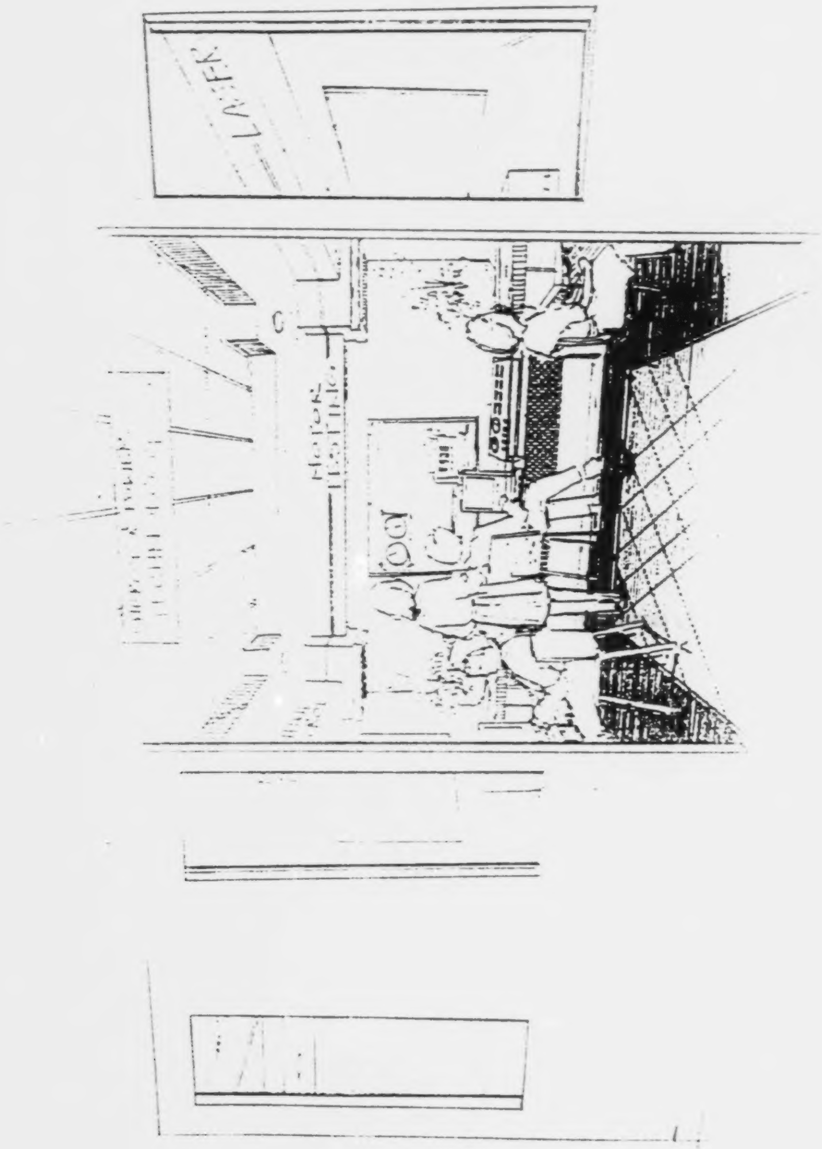

LASER
MOTOR TESTING

Figure III-10

Module Concept

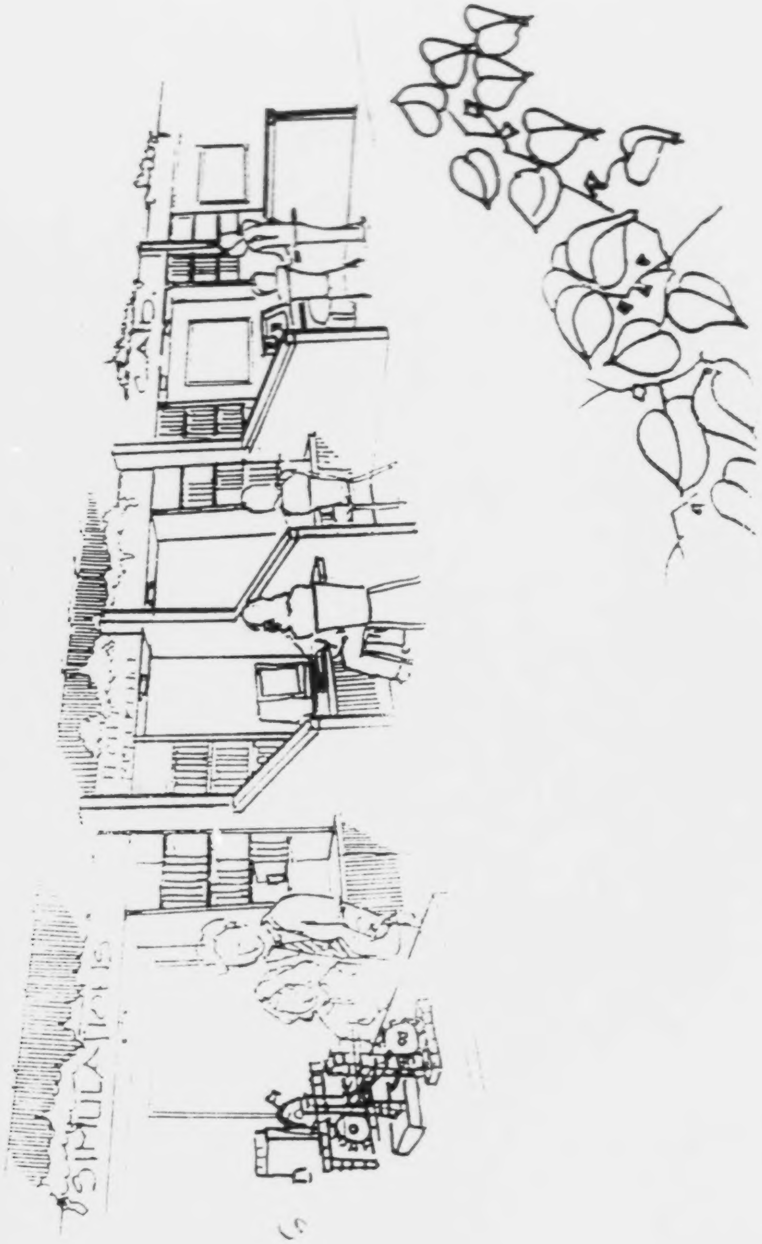
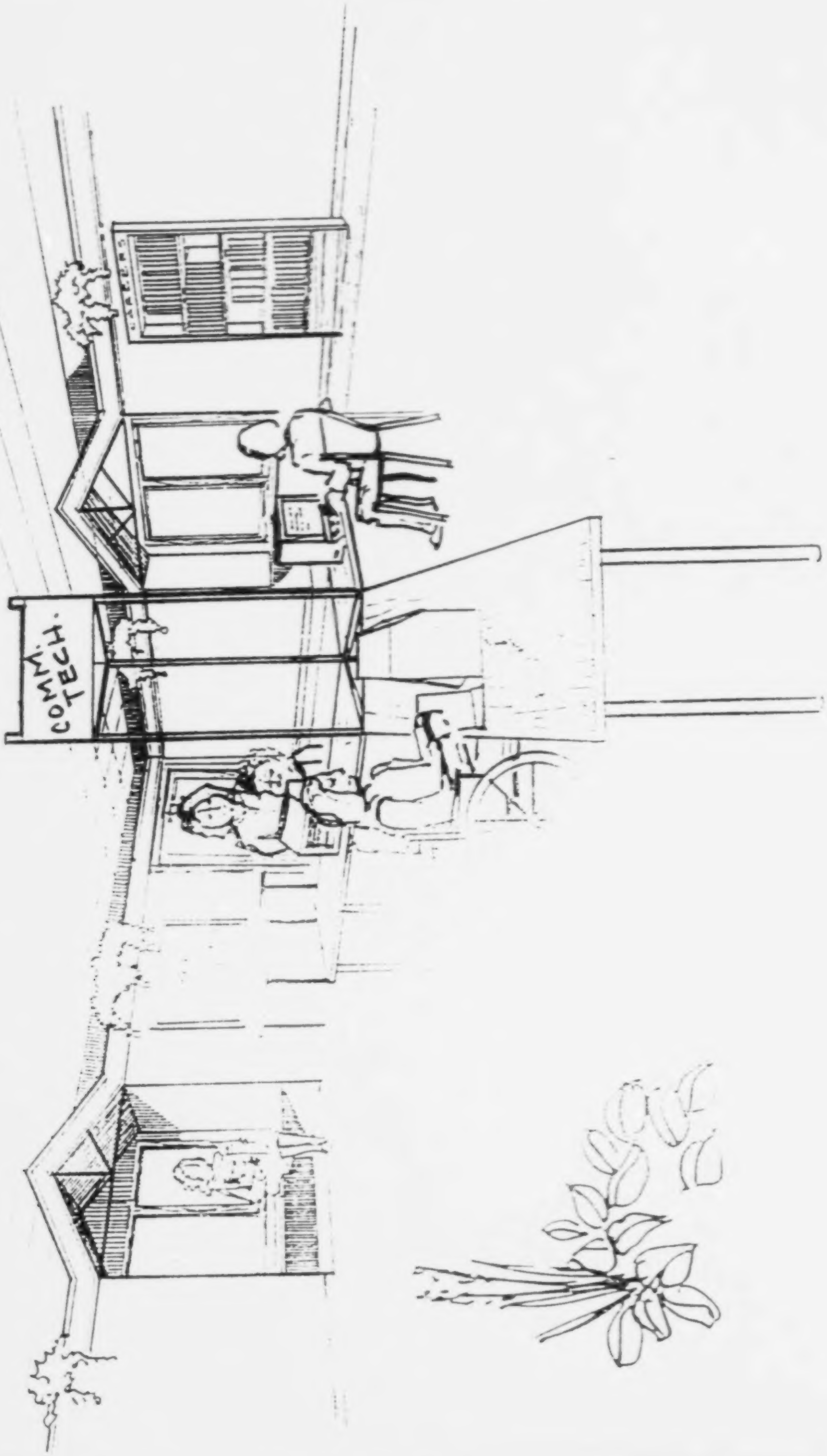

SIMULATIONS
C.A.D.

Figure III-11

Simple Module Configured from Tables


COMM. TECH.
CAREERS

7. Planning New Facilities

Overview of the Process

The ***ITE/TE curriculum*** is the base for facility planning. This must be emphasized because facilities ***must*** reinforce the goals of the curriculum — this is the key to a successful facility. Beginning here is equally important when planning new facilities or when updating existing facilities.

Often, it is desirable to establish a local Industrial Technology/Technology Education program planning committee to help design the facility. Candidates for such a committee include: industrial education teachers, local supervisors, local administrators, state or university consultants and a representative, preferably from industry, of the local program's advisory council. Committee members should be well aware of the local school situation and should be provided with reference materials which will aid in the planning. Wisconsin's guidelines suggest such information should include: state accreditation standards, related local and state laws and regulations, school philosophy and goals, an outline for preparing educational specifications, trends in industrial education and estimated construction and equipment funds available (Stallsmith, 1977, p. 5).

Overall, there are three distinct phases in the facility planning process — ***Phase One*** involves a thorough review of the curriculum, including the overall philosophy and goals for the program. ***Phase Two*** involves translating the Phase One goals into facility designs and plans. The final phase, ***Phase Three,*** is when the proposal is transformed into detailed drawings, construction and equipment acquisition. The steps within these phases are:

Phase One

1. Thinking through the program's philosophy
2. Identifying and setting curriculum goals
3. Developing a curriculum plan including an identification of specific courses which will be taught (including future projections)

Phase Two

4. Determining key ITE/TE facility design criteria
5. Deriving educational specifications from the curriculum:
    - Space needs
    - Auxiliary spaces
    - Space relationships
6. Interacting with the architect

Phase Three

7. Equipment layouts
8. Construction
9. Acquisition of equipment and materials
10. Installation of equipment
11. Ongoing evaluation and modifications

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Developing a Facility Design Portfolio

The preparation of a facility portfolio is extremely important. In order for good planning to achieve results, it is essential that it be packaged into a format which effectively, clearly, and professionally communicates the facility proposal. Remember, the portfolio is much more than a collection of information. It is also an extremely important *communication piece*. As such, careful attention should be given to make certain that it presents the proposal in the most positive and professional manner possible. The portfolio serves several major functions:

- It is a means of communicating the goals and key ideas to the administration.
- The proposal planning process can be an extremely effective means of helping ITE/TE faculty think through their educational goals and philosophy as well as possible new courses, changes in emphasis, etc. Solid facility planning simply ***must*** be based on a solid foundation of educational planning.
- It is the point of linkage between curriculum clarification and facility design.
- It can serve as an effective tool for educating architects, guidance counselors, school board members, parents and others about ITE/TE.

Several suggestions should be kept in mind during the portfolio preparation process:

- Even though the proposal will be first presented to the building administrator, it should be written with other administrators, board members, architects, etc, in mind.

Remember, the portfolio is much more than a collection of information. It is also an extremely important communication piece.

- Don't overwhelm the administration with too much information. A proposal portfolio should be direct, attractive, concise, and accurate. Supporting documentation (such as course and unit outlines) can be placed in an appendix. It should be able to be easily and quickly read by professional people who are frequently pressed for time.
- The proposal should include a cover letter which serves as an introduction and orientation to the portfolio's content.

For suggested components for a facility proposal portfolio, see Figure III-12.

Figure III-12

Facility Proposal Portfolio Outline

Cover Page:

The proposal should have a professional looking cover page. This is the readers' first impression so it must catch his/her attention. An example might be a creative technology logo or the school logo with an eye catching technology phrase.

Philosophy:

Proposed changes in facilities should be accompanied by proposed changes in educational philosophy. A statement of the new philosophy should be a minimum of a paragraph and no longer than one page (see Chapter I).

Goals:

Following the philosophy statement should be a statement of the program goals. These statements should outline the effects of the curriculum and facility revision. It would also be advisable to direct additional goal statements to the cognitive, affective and psychomotor domain (see Chapter I).

Courses:

This section should contain the course title, a short description, and the course objectives. Following should be the course units and their objectives, and a description of the activities and the equipment that will be used for each activity. This section should be very detailed so as to show you have done your homework and know how all monies will be spent (see Chapter II - Planning the ITE/TE Program).

Equipment List:

The equipment list should include a detailed description (model #, size, and vendor) or each item, the quantity and item price with a total price. Again this shows the detailed preparation for the revision (see chart below).

Floor Plans:

A set of preliminary floor plans should show existing space and new space, utility line runs, and furniture/furnishings placement.

Total Cost Estimate:

This should be an estimate, broken down into categories, of the total cost of the project. It is important to view this as a preliminary estimate. Administrators will want to have some idea of the bottom line costs. While the architect will eventually be responsible for developing detailed cost estimates, preliminary figures can be compiled by some consultation with local contractors, vendors, others schools who have recently undergone renovation, etc.

Equipment/Furniture Utilization & Planning Form

Proposed Use	Item #	# Reqd.	Equipment/Furniture Description	Recommended Sale	Sale Value
Existing					
New	Item #	# Reqd.	Equipment/Furniture Description	Vendor Recomended	New Cost

Figure III-13
Equipment/Furniture Work Sheet

8. Determining Design Criteria

Space Characteristics

Facility design should be thought of and approached as creating a ***total environment*** for learning. Viewed this way, facility design goes far beyond considerations such as physical layout. Learning environment design includes a wide range of social, physical and technical factors designed to promote the best interaction possible between teachers, students, and instructional objects. The primary objective of the facility design process should be to ***create a learning environment*** which can effectively bridge educational goals with student learning. Important design criteria which will promote this process include:

Flexibility of Space

Rapid changes in technology are placing new demands on Industrial Technology/Technology Education facilities. One of the most important of these changes is that changes must be able to accommodate new equipment, different configurations, and new topics as they emerge. The bottom line is that ITE/TE facilities of the future are going to have to be designed to be as flexible as possible. Some suggestions regarding how to accomplish this are:

- Use of flexible movement devices, e.g., casters, rollers, or air bearings for equipment, cabinets, etc.
- Non-attached furniture
- Components or modular designs
- Moveable wall panels
- Multipurpose space usage - examples could include:
  - Finish room also used as a test rocket stand
  - Television studio used as a conference room
  - Darkroom used for light-sensitive plant testing

Utilities

Careful attention and planning should be given to the proper placement of utilities. Important criteria for configuring the systems include safety, flexibility, and appearance. Among the methods which can be considered in the design process include:

- Expansion conduit
- Fibre optic cabling
- Grid system (in ground or power post)
- Bus bar system

The Industrial Technology/Technology Education facility will need to give attention to the following utilities.

- Phone lines (dedicated for FAX, bulletin boards, etc.)
- Computer connections
- Air
- Electricity
- Water
- Drainage
- Exhaust
- Gas
- T.V. cable

Aesthetics

The modern Industrial Technology/Technology Education facility is evolving into something quite different from the traditional, unit shop-oriented facility of the past. One of the areas where this change is being felt most directly is in the area of aesthetics. It is very important that modern labs look good. Labs should be designed to make an overall visual impact. This is important for a number of reasons including:

- Attractive facilities send the clear message to parents, administrators and the rest of the school that something exciting and important is happening in our field.
- A sharp and attractive appearance sends a signal to the students that this is a learning environment.
- Attention to aesthetics can engender pride in students, stimulate learning, and provide motivation.
- A good-looking facility promotes an image of excellence and high expectations.
- A high-quality appearance sends the message that the future is now.

Important aesthetic considerations include:

- Color coordination
- Lighting
- Furnishings
- Floor, wall, and ceiling coverings
- Plants
- Cornices
- Drop cord placement and concealment
- Signs and poster quality and placement
- Tone
- Display area planning
- Facility materials mix (dry wall, carpet, trim, etc.)
- Housekeeping
- Texture of the wall, ceiling, floor, and furniture surfaces
- Balance of color, lighting, and overall proportions
- Type of trim
- Painting type and color

Accessibility to the Handicapped

Among the important factors which should be considered when building or renovating facilities, is accessibility for handicapped persons. Sound designs will include attention to factors such as:

- Door widths
- Work counter heights
- Counter depths
- Equipment and work space signage
- Floor covering type
- Clearances around furniture and equipment
- Ramps

Some specifications have been developed by the U.S. Architectural and Transportation Barriers Compliance Board for use by facility planners. These include standards which should be used in the design process. Wheel chair access standards are pictured below (see Figure III-14).

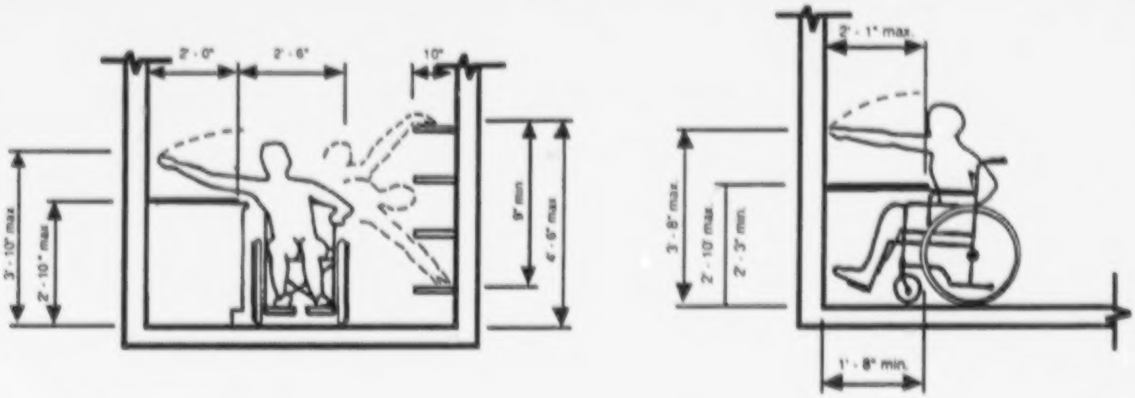


Figure III-14

Standards for Storage Units (U. S. Architectural and Transportation Barriers Compliance board, 1981)

Control/Supervision

Many new kinds of activities and teaching arrangements are being explored. The individual project and lecture are giving way to more individualized and small group learning. These changes have some important implications for facility design:

- Total visual access to the entire facility should be maintained
- Consideration should be given to a call system (sound or visual)
- Intercom/Announcement capability
- Security must be planned for
- The instructor should have main power switch control
- An amplified public address system should be considered
- Rheostat controlled lighting and specialized spot lighting of certain areas could be desirable
- Intercom systems to help with supervision when students are non-visually accessible

Laboratory Security

Much of the equipment in the modern ITE/TE laboratory is not only expensive; it's also compact and could easily be moved. The design of the facility should attempt to maintain a balance between security and availability to the students. The following kinds of concerns should be addressed:

- Arranging for lockable areas
- Lockable power switches
- Alarmed exit doors
- Security cables
- Computer information security
- Security for computer/video
- Tool storage
- Materials storage
- Student project storage
- Lockable storage
- Master keying

Safety

Working with the new technologies often means that teachers may be working with processes and materials that are relatively new to them, e.g. lasers, chemicals, composites, super-chilled gasses (e.g., nitrogen), various experimental combinations, etc. It is therefore very important that the following considerations be followed:

- Carefully read all product information sheets and identification storage requirements
- Consult with other teachers if you are unsure about a process or material
- Contact state department personnel
- Contact safety inspection representatives
- Consult with health officials

Specific attention should be given to the following items:

- Railings
- Guards
- Home-made devices (guarding, electrical protection, etc.)
- Special needs and disability concerns
- Egress needs
- Fire regulations (contact the local fire department)
- Fire escape
- Ground fault interrupt device protection
- Capacity limitations
- Fire extinguishers
- Communication capability with the office
- Lighting adequacy
- Traffic flow considerations
- Builder's codes
- Local codes
- Health codes
- National Electrical Code

Noise Level and Control

Even though the equipment in many facilities is moving away from the large and noisy varieties, noise containment remains an important design consideration. Remember, the goal is to develop a positive learning environment. If the acoustics are poor, the overall quality of the environment can suffer. It is important to consider the following:

- Isolation of noisy equipment
- Assess a facility/equipment noise level
- Use of sound absorption materials (ceiling, walls, and floor)
- Control of noise at the source
- Machine mounting pads
- Wear/require hearing protection (e.g., ear plugs)
- Ceiling height

Instructional Technology

The new technologies are bringing major changes in the area of instructional technology. Blackboards and overheads are giving way to computer projection devices, CD-ROM, laser discs, large screen projection and more. The power demands and availability are much different from those of older facilities. Among the factors which should receive attention are:

- Inter-station communications including:
  - Intercom
  - Modem
  - Cable for T.V.
  - Telephone
  - Satellite feed
- Light level control
- Projection surfaces
- Power outlet configuration
- Arranged space for use and storage of various devices

Environmental Control

As with the other design considerations, the environmental control issues are changing for the modern ITE/TE facility. Concerns for dust collection and smoke elimination have given way to climate control for computers and other delicate equipment. Important environmental factors which should be addressed include:

- Heating and cooling
- Humidity
- Hazardous vapor elimination
- Dust/Particle control
- Ventilation and air circulation
- Pressurized clean areas

Equipment

Facility design also includes the important component of equipment selection and planning. Among the important variables which should be considered are:

- Scale and size of equipment
- Anticipated future equipment procurement
- Educational or industrial
- Simulation or real
- Table-top or fixed
- Built-in or portable
- Power requirements (e.g., 3 phase)

Furnishings

An important part of any environment is furnishings. Many of the design considerations that hold for facilities in general are also very important for furnishings—for example, flexibility and aesthetics. Furnishings are part of the total learning environment. Poor furnishings can ruin an otherwise beautiful effect. Among the important concerns which should be addressed are:

- Portable or built-in
- Kinds of work surfaces
- Durability
- Safety
- Visual impact
- Flexibility of use
- Expense

Lighting Considerations

The United States National Safety Council has estimated that insufficient lighting was the primary cause of 5% of all industrial accidents and that in 20% poor illumination and eye fatigue played a part. Numerous studies indicate that worker accident and error rates decrease when lighting is improved in industrial settings

(Grandjean, 1969). Due to its importance, lighting design factors will receive some extended discussion.

Lighting Hints

- Avoid placing light sources in the direct visual field of the operator
- Light sources should be screened (shades, screens, etc.)
- The light source should be a minimum of 30 degrees above horizontal
- In large rooms where the 30 degree minimum is impossible, all illuminants must be screened on the sides
- Avoid designs incorporating polished or highly reflective surfaces on machines, table tops, or other objects in the direct line of sight
- Since desks and benches are frequently located along walls, a distance of 2 1/2 feet from the wall to the illuminary should be maintained
- To improve uniformity across a room, it is recommended that somewhat closer spacings exist between outer rows of luminaries than between central rows
- The ends of fluorescent illuminary rows should optimally be 6"-12" from the walls and never more than 24"
- Closer spacings are recommended in situations where reduction of harsh shadows is desirable or necessary

Numerous studies support a dramatic decrease in accident and error rates as a direct result of increased levels of illumination.

Specific Lighting Level Recommendations

Specific recommendations for lighting levels are shown in Figure III-15. Foot-candles readings can be obtained by using an industrial photometer (or by converting values from a photographic light meter).

Figure III-15

Specific Lighting Level Recommendations

Area	Foot-candles
Construction/Manufacturing Processing	
Assembly	
Medium assembly	100
Fine assembly	500
Machine Shop	
Rough bench and machine work	50
Medium bench and machine work,	100
Fine bench and machine work, grinding, fine buffing, and polishing	500
Extra fine bench and machine work, grinding, fine work	1000
Finishing	
Dipping, simple spraying, firing	50
Fine hand painting and finishing	100
Extra fine hand painting & finishing	300
Materials Testing	
Inspection	
Ordinary	50
Difficult	100
Very difficult	500
Most difficult	1000
Offices	
Regular office work, reading good reproductions, reading or transcribing handwriting in hard pencil or on poor paper, active filing, index references, mail sorting	100
Reading high-contrast or well-printed material, tasks and areas not involving critical or prolonged seeing such as conferring, interviewing, inactive files, washrooms	30
Corridors, elevators, escalators	
Stairways	20
Lecture rooms	70
Toilets and washrooms	30
Graphic Design & Layout	
Color inspection and appraisal	211
Machine composition	100
Press operation	70
Proof reading	150
Drafting rooms	100
Shops	150

9. *Educational Specifications*

Educational specifications should be built on the base of the ITE/TE program's scope and sequence. They should be firmly grounded in the major goals for general education and Industrial Technology/Technology Education as well as individual program philosophies. Once this groundwork has been carefully laid, then the additional educational specifications can be developed. Educational specifications are outlines of the key standards or specific factors which should be built into a facility plan.

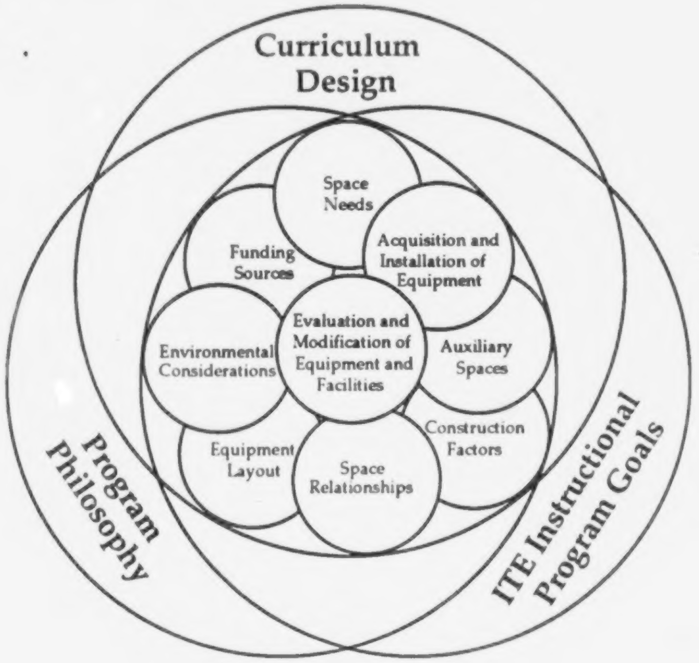
There are numerous examples of specifications. When someone decides to build a home, a list of key specifications is typically developed which serves to communicate essential information to the builder or architect. These could include square footage, installation values, utility types, etc. Educational specifications function in precisely the same manner. They serve to provide an outline of the essential factors and top priorities of the facility plan. It is critically important to stress that these must first and foremost be ***educational*** specifications. Each factor should be considered on the basis of its solid connection with the educational goals and program philosophy. As such, specifications will guard against the tendency to base facility design on factors which may be less than wise from an educational perspective.

This section will outline and discuss the key educational factors which should be specified when building or renovating a facility. These are presented in graphic format below (Figure III-16).

> **Facility design should be based on educational specifications. They should be firmly grounded in the major goals for general education and technology education as well as individual program philosophies.**

Figure III-16

Educational Specifications Factors for Facility Design


Curriculum Design
Space Needs
Funding Sources
Acquisition and Installation of Equipment
Evaluation and Modification of Equipment and Facilities
Environmental Considerations
Auxiliary Spaces
Construction Factors
Equipment Layout
Space Relationships
Program Philosophy
ITE Instructional Program Goals

The following section provides a comprehensive listing of the educational specification factors which should be considered when planning facility changes. While each factor will not apply to each program, they should nevertheless be carefully considered, particularly in light of program changes which may be projected for the future. Certainly, one of the primary factors involved in developing educational specifications for modern ITE/TE facilities is *FLEXIBILITY*. Every attempt must be made to assure that planning be done with a clear eye on future directions and needs.

Philosophy

The point made in the Overview of this section should be stressed again. The place to begin the process of facility design (and redesign) must ***not*** be with facility planning. If facility planning is to ultimately be successful, it must be based on a careful review of the program's curriculum. Only ***after*** the all-important curriculum planning process is completed is facility planning ready to begin. Therefore, the first question in facility planning is not, "Where do we put the walls?" Rather it should be, "What do we plan to teach?"

If facility planning is to ultimately be successful, it must be based on a careful review of the program's curriculum.

The new emphasis on technology has meant a definite shift in ITE/TE philosophy and educational goals. The "shop" of the 50's, 60's and 70's falls short of the needs of these new programs. Facilities different from the traditional industrial arts shop are being developed. New Industrial Technology/Technology Education strategies are focusing on conceptual knowledge of the various techniques (technical skills) with a solid understanding of the technological systems and how they interrelate to each other while interfacing with other disciplines such as mathematics and science.

Trends suggest that the 90's will see more action in the discovery aspects of Industrial Technology/Technology Education at the elementary level. Students will need to learn to use knowledge to design solutions for problems, and techniques to prototype models that demonstrate the appropriateness of the design solution. Such activity requires facilities that support research, designing, prototyping, testing and storage.

In past years, high school industrial arts programs have been set up as unit shops in drafting, graphic arts, woodworking, metalworking, electricity/electronics, and power. The decade of the nineties will see a shift from unit areas toward an emphasis on technological systems laboratories. In Missouri these are (a) Materials and Processing, (b) Energy and Power (instrumentation and control), and (c) Communication. These systems will require modern facilities which contain up-to-date tools and equipment. Lab designs will need to include space for research and experimentation as well as a classroom area for lectures and discussion. Equipment will move from the floor to the desktop in configurations that provide for maximum flexibility. With the introduction of more sensitive electronic equipment for each application, dust, fume and storage considerations will be more critical than ever (adapted from Wright, 1991).

The changes in curriculum which are occurring in Industrial Technology/Technology Education show a recurring theme; —namely that there is a shift in programs toward the higher-level, design-oriented, technological problem-solving experiences than formerly occurred in most industrial arts programs. Collaborative and innovative problem-solving skills cannot easily be learned in a routine and tightly controlled environment. Modern Industrial Technology/Technology Education facilities should be based upon enabling dynamic technological problem-solving in a broad range of technologies (adapted from Doyle, 1991).

Instructional Program

The Department of Design and Environmental Analysis in the New York State College of Human Ecology developed six questions to be answered by an environmental analyst as preparatory to the design of human environments (Todd, 1974).

- What objectives or goals are these physical and social arrangements created to accomplish?
- Is there a particular philosophy, theory or point of view to be followed in achieving these objectives?
- What behaviors or activities must be carried out?
- Where do these behaviors and activities happen?
- What kinds of procedures, routines or programs have been developed and put into practice to help achieve the objectives?
- When are goal-related behaviors exhibited and in what sequence?
- Summarize the scope and sequence of courses to be offered in the Industrial Technology/Technology Education program according to grade level.
- List the courses by title and give a brief description of their content.
- Give a short description of the types of teacher and student activities to be implemented in each facility.

Space Needs

Once the instructional program is defined and the scope and sequence of courses established, space needs should be established as a vital part of the educational specifications. Numerous factors must be weighed in determining space:

- Estimate school enrollment
- Estimate of Industrial Technology/Technology Education enrollment (youth & adult)
- Use class size estimates to calculate the number of class sections necessary
- Determine square footage per laboratory and auxiliary areas
- Consider the type of program being offered including anticipated curriculum changes
- Anticipate the kinds of equipment changes which will be made.
- Provide for the needs of special needs populations
- Evaluate traffic flow and station allowances

Each school is different. Therefore, it is necessary to estimate space according to the local conditions. There is a minimum size for laboratories of given types. For specific square footage minimum recommendations, refer to Tables III-1, III-2, and III-3 below.

Table III-1
Square Footage Minimum Recommendations

SQUARE FOOTAGE OF LAB/TEACHER STATIONS			
School Enrollment	Minimum*	Recommended*	Optimum*
0 - 500	2400/1	3600/2	4800/2
501 - 1000	3600/2	5400/3	7200/3
1001 - 1500	5400/3	7200/4	9600/4
1501 - 2000	7200/4	9000/5	12000/5
2001 - 2500	9000/5	10800/6	14400/6
2501 - 3000	10800/6	11600/7	16800/7

***Based upon 20 students per class/lab (does not include planning area but includes storage and finishing areas)**

Facility Planning Guide. Technology Education Association of Pennsylvania. Pennsylvania Department of Education.

Table III-2
SPACE RECOMMENDATIONS GRADES 6-9 [1 & 2]

Industrial Technology/Technology Education Course	
General Data (Applies to all laboratories unless listed differently)	Office .... 150 sq. ft. • Processing/work area .... 35% of overall lab area • Class discussion .... 15% of overall lab area • Bench surface .... 15% of overall lab area • Student storage .... 10% of overall lab area • Machine footprint .... 10% of overall lab area • Material storage .... 5% of overall lab area • Supply storage .... 5% of overall lab area • Resource center .... 5% of overall lab area
Introduction to Technology	3240 square feet inclusive 80-135 sq. ft. per student • Materials & Processing area .... 1620 sq. ft. • Communications area (dust free) .... 810 sq. ft. • Energy & Power area .... 810 sq. ft.
Exploration of Technology	3240 square feet inclusive 100-135 sq. ft. per student • Materials & Processing area .... 1620 sq. ft. • Communications area (dust free) .... 810 sq. ft. • Energy & Power area .... 810 sq. ft.

---

[1] **Existing Facilities:** Recommended square feet per student safe area. New facilities should be approx 20% larger than old facilities.

[2] **New Facilities:** Recommended design standard should be for a maximum class size of 24 students. All space recommendations contained in this section are based on that recommendation.

Table III-2

SPACE RECOMMENDATIONS GRADES 6-9 (continued)

Communication Technology Laboratory	2400 square feet inclusive * 50-100 sq. ft per student overall • Graphic design and production area (CAD, layout, drafting, etc.) .... 1000 sq. ft. • Storage area .... 500 sq. ft. • Darkroom .... 150 sq. ft. • Video control room .... 150 sq. ft. • Stage area .... 150 sq. ft. • Video production/edit area .... 100 sq. ft. • Audio production area (MIDI interface.. 100 sq. ft. • Audio control room .... 100 sq. ft.
Energy & Power Technology Laboratory	2880 square feet inclusive * 80-120 sq. ft. per student overall • Electricity/electronics systems area ...... 1200 sq. ft. • Transportation systems area .... 1000 sq. ft. • Mechanical systems area .... 600 sq. ft. • Alternative energy area .... 600 sq. ft. • Fluids area (oil, water, etc.) .... 600 sq. ft. • Propulsion area (Rocketry) .... 600 sq. ft. • Storage area .... 400 sq. ft.
Materials & Processing Technology Laboratory • Manufacturing • Construction	2880 square feet inclusive * 80-120 sq. ft. per student overall • Construction/manufacturing processing area .... 2000 sq. ft. • Design & production planning area .... 600 sq. ft. • Project and product storage .... 600 sq. ft. • Materials storage area .... 300 sq. ft. • Finishing room .... 150 sq. ft. • Materials testing area .... 100 sq. ft. • Small equipment storage .... 100 sq. ft.
Multi-Purpose Room Classroom Area	.... 900 sq. ft.

* Not all facility areas need be incorporated. Selection is dependent on curriculum and program.

Table III-3

SPACE RECOMMENDATIONS GRADES 9-12

Industrial Technology/Technology Education Course	
General Data (Applies to all laboratories unless listed differently)	Office .... 150 sq. ft. • Processing/work area .... 35% of overall lab area • Class discussion .... 15% of overall lab area • Bench surface .... 15% of overall lab area • Student storage .... 10% of overall lab area • Machine footprint .... 10% of overall lab area • Material storage .... 5% of overall lab area • Supply storage .... 5% of overall lab area • Resource center .... 5% of overall lab area
Exploration of Technology (All 3 technologies taught in one facility) General Laboratory	3840 square feet inclusive 100-160 sq. ft. per student • Materials & Processing area .... 1920 sq. ft. • Communication area (dust free) .... 960 sq. ft. • Energy & Power area .... 960 sq. ft.
Multi-activity Facility (2 or more classes simultaneously in facility)	Add the square feet recommendation for each and multiply the total by .75.
Communication Manufacturing Graphics Construction Graphics Engineering Graphics Graphic Communication Electronic Communication	2880 square feet inclusive * 60-120 sq. ft per student overall • Graphic design and production area (CAD, layout, drafting, etc.) .... 1200 sq. ft. • Storage area .... 600 sq. ft. • Darkroom .... 180 sq. ft. • Stage Area .... 180 sq. ft. • Video control room .... 120 sq. ft. • Audio control room .... 120 sq. ft. • Audio production area (MIDI interface) 120 sq. ft. • Video production/edit area .... 120 sq. ft.

* Not all facility areas need be incorporated. Selection is dependent on curriculum and program.

Table III-3

SPACE RECOMMENDATIONS GRADES 9-12 (continued) [1 & 2]

Energy & Power Energy Systems Electronics Energy and Power Electrical Systems Computer Applications Transportation Systems	3480 square feet inclusive * 100-145 sq. ft. per student overall • Electricity/electronics systems area ...... 1440 sq. ft. • Transportation systems area .... 1200 sq. ft. • Fluids area (oil, water, etc.) .... 720 sq. ft. • Propulsion area (rocketry) .... 720 sq. ft. • Alternative energy area .... 720 sq. ft. • Mechanical systems area .... 720 sq. ft. • Storage area .... 480 sq. ft.
Materials & Processing Manufacturing Systems Construction Systems Research and Development	3480 square feet inclusive * 100-145 sq. ft. per student overall • Construction/manufacturing processing area .... 2400 sq. ft. • Design & production planning area .... 720 sq. ft. • Project and product storage .... 720 sq. ft. • Materials storage area .... 360 sq. ft. • Finishing room .... 180 sq. ft. • Small equipment storage .... 120 sq. ft. • Materials testing area .... 120 sq. ft.
Multi-Purpose Room Classroom Area	.... 900 sq. ft.

[1] **Existing Facilities:** Recommended square feet per student safe area. New facilities should be approx 20% larger than old facilities.

[2] **New Facilities:** Recommended design standard should be for a maximum class size of 24 students. All space recommendations contained in this section are based on that recommendation.

Auxiliary Spaces

In order for ITE/TE facilities to work effectively, suitable auxiliary spaces are absolutely necessary. These include storage areas for tools, materials and projects, finishing rooms, darkrooms, office space, classrooms and many others as facilities become more specialized. The following types of auxiliary spaces should be considered and evaluated:

- Tool storage
- Moveable wall sections
- Materials storage
- Hazardous materials disposal
- Storage for portable supply and equipment modules
- Clean-up supplies storage
- Filtered power
- Clean area for specialized activities (e.g., computers)
- Sound isolation space
- Testing area
- Space for maintaining and storing records
- Technical library space
- Research and development area
- Biological research area
- Studio space
- Instructor's office area
- Finishing room space
- Rest rooms

Space Relationships

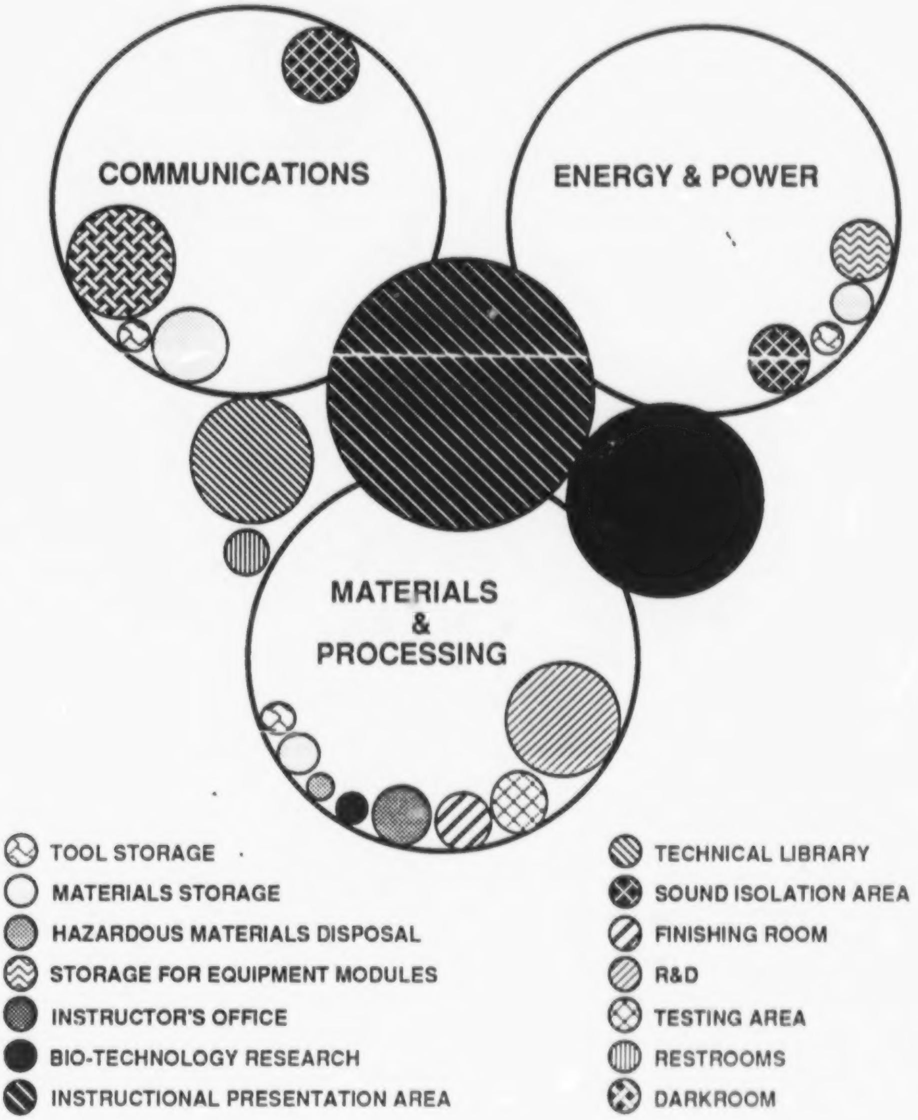
The Industrial Technology/Technology Education department is an integral part of the total school building and should be designed this way. It is normal to position the laboratories on the perimeter of the building because of materials deliveries, the need for large overhead doors and sound control, but they should not be designed as an appendage to the main school building. As an integral part of the educational program, they should be easily accessible to other areas of the school so interdepartmental activities may be implemented.

One particularly useful way of beginning the space organization process is to make a listing of all of the space needs which should be designed into the space. Once this has been completed, assign each space a proportionately sized "bubble." The size of the bubble should indicate the approximate amount of space which a particular room or activity type is expected to use. Next, combine and arrange individual "bubbles" into the larger spaces in which they will be contained. NOTE: This technique is not designed to designate or design specific spaces, placement of walls, equipment, etc. Rather, it is designed to provide an approximation of space needs and the interrelationship between spaces. A sample Space Relationship Bubble Diagram is provided below. Spaces could also be designated by using colors or numbers.

> **The technology education department is an integral part of the total school building and should be designed this way.**

Figure III-17

Space Relationship Bubble Diagram


COMMUNICATIONS
ENERGY & POWER
MATERIALS & PROCESSING
TOOL STORAGE
MATERIALS STORAGE
HAZARDOUS MATERIALS DISPOSAL
STORAGE FOR EQUIPMENT MODULES
INSTRUCTOR'S OFFICE
BIO-TECHNOLOGY RESEARCH
INSTRUCTIONAL PRESENTATION AREA
TECHNICAL LIBRARY
SOUND ISOLATION AREA
FINISHING ROOM
R&D
TESTING AREA
RESTROOMS
DARKROOM

Equipment Layout

One of the most essential features of ITE/TE laboratories of the future regarding equipment layout and placement is ***flexibility***. Clearly the trend is toward smaller equipment and table-top technology. Additionally, the ITE/TE curriculum is demanding new kinds of equipment including lasers, computers, satellite communications, and much more. Much of this equipment is being packaged in modules which provide for easy movement and storage.

One of the most essential features of ITE laboratories of the future regarding equipment layout and placement is flexibility.

It is essential that equipment lists and equipment layouts become a part of the specifications for the architect. It is quite likely that he/she will assume that the equipment needs and layout are much like they have been in traditional Industrial Arts shops. It is very important that they receive thorough orientation to the new layout requirements. Factors which should be considered include:

- Layout for each laboratory, where fixed and movable equipment will be located
- Give quantity, name, size, floor space (including operator space) and utility requirements for each major piece of equipment
- Give a high priority to future flexibility
- Evaluate safety zones and concerns
- Consider traffic patterns through the laboratory
- Equip larger machines with casters, air bearings, or other movement aids
- Design for flexibility in utilities
- Use strip power
- Arrange lighting to provide for equipment flexibility (in some cases equipment will need to be equipped with specialized lighting)
- Consider the machines which will likely need to be placed closely to one another as well as those which may need to be integrated into modules
- Include students in the layout planning process. (This is valuable learning for them as well.)

Construction Factors

During the construction the ITE/TE instructor should maintain contact with the architect and contractor concerning the progress of the building or remodeling. Often there emerge electrical, plumbing or other questions that need clarification that only an instructor familiar with the ITE/TE program can provide.

10. Interacting with the Architect

Instructors and school system administrators are encouraged to work toward playing an active role in the development of new facility plans. This means that the teacher should be afforded the opportunity to interact with the architect who will design the new facility. This is important because architects are usually not expert in the requirements of the technological curriculum nor are instructors expert in school architecture. What is needed is the systematic blending of the two areas of expertise. This can only come through face-to-face discussion. Mere paper, or even limited oral communications, will not achieve the desired ends.

The architect is one of the valuable human resources who can be tapped through the facility change process. Basically, the architect is in a service profession. His/her primary responsibility is to insure sound, safe, and supervised planning. The current climate of transition in ITE/TE has created some new and very important challenges in working with architects. Simply put, many architects look at our field and our labs and think "*shop*." Certainly, they aren't to be faulted for the misperception. The facility requirements are changing; therefore, careful attention needs to be given to interpreting these new directions to the architect.

Teachers should interact with the architect who will design the new facility. Architects are usually not experts in the requirements of the technological curriculum.

The architect serves several valuable functions. Among these are:

- Making sure the codes and other legal requirements and responsibilities are met
- Interacting with clients to translate ideas and input into pleasing and functional designs
- Developing cost estimates in accordance with budget specifications and constraints
- Monitoring job progress. (It is important to note that, while the architect is ultimately responsible, the ongoing assistance of and input from the ITE/TE point person, is both needed and welcome. Certainly, it is very important that this be done with diplomacy, in a manner that conveys respect for the expertise of the architect.)

Some useful tips to keep in mind when working with architects are:

- Do your homework. Most architects will greatly appreciate information regarding space and equipment needs information, technical specifications, and other preliminary design work. Your sound preliminary thinking will assist the architect in better meeting your goals and needs
- Always show respect for the architect's knowledge and input; but, be prepared to give your (and your faculty's) input as well
- Remember, the architect who visits the school is usually not the one who draws the plans. Therefore, it is important to remain in touch with the architectural firm and to pass information along on paper. This is particularly important given the changing needs of the ITE/TE profession.
- Have a designated person to relate with the architect. It is important to clarify the lines of communication between the architect, administration, and faculty. These will be different for each situation. Clarify and then carefully maintain the proper channels

- It is important that the administration be kept well informed throughout the building or renovation process. Some architects will take point on this. In other cases, it will be up to a member of the faculty to keep the channels of communication open
- Early in the project, give the architect a copy of the formal facility change proposal including the educational goals and curriculum. This will provide valuable information which will help him/her better understand the changing facility needs of ITE/TE
- Provide the architect with photographs or video of some model technology laboratories. This provides a valuable means of communicating the look and requirements of updated facilities. Of course, the best alternative would be to facilitate a tour of selected model programs with the architect (as time permits)
- As the project nears completion, maintain a good listing of the loose ends that need to be completed before the project is signed off. This will make the architect's job go more smoothly and will expedite the time-consuming end-of-project detail

Provide the architect with photographs or video of some model technology laboratories. This provides a valuable means of communicating the look and requirements of updated facilities.

The following table is designed to provide a check-off format to interface the facility design considerations (Figure III-18) with the architect's activity.

Figure III-18

Architect Interaction Worksheet

Design Considerations	Implementation Description	Architect's Rough Drawings	First Set of Plans	Working Drawings
Flexibility of Space	**(example: Construction of moveable modules)**	✓	✓	
Utilities				
Aesthetics				
Control/ Supervision				
Laboratory Security				
Safety				
Noise Level and Control				
Instructional Technology				
Environmental Control				
Equipment				
Furnishings				

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11. Equipping the Program

The ITE/TE instructor faces major responsibilities in equipping the ITE/TE facility(ies). In doing so he/she must always keep in mind the often conflicting demands of safety, flexibility, relevance to curriculum and costs.

Acquisition and Installation of Equipment

Immediately following approval of expenditures, work must begin on the actual acquisitioning of equipment and materials. This typically is the responsibility of the Industrial Technology/Technology Education teachers or supervisors who will be working in each of the laboratories. If the equipment list formulated during the development of educational specifications was done well, this step should be relatively easy. The ITE/TE instructor should:

- Take the initiative in anticipating and promoting the need for essential equipment
- Maintain an ongoing "punch list" of equipment including an indication of priority and approximate cost
- Become familiar with the school's procurement policy and procedures
- Carefully align projected equipment needs with educational goals and future projected program changes
- Make certain that you are involved in the tool and equipment specification and check-in processes
- Establish and maintain an inventory and maintenance database for all equipment
- Arrange for appropriate storage of all manuals, supplier information, and warranty information, etc.
- Be certain to inquire into the availability of extended service warranties for particularly fragile or complex equipment
- Arrange for training on specialized equipment—if possible, video-tape the sessions for later reference
- Consider including students in the training sessions (as appropriate)
- Arrange to have a utility crew present upon the arrival of specialized equipment as needed.
- If at all possible, avoid fixed placement of equipment. Remember, the future of ITE/TE demands *flexibility*

Figure III-19 presents a sample inventory and equipment maintenance record computer database.

Figure III-19

Sample Database Fields

Cost
Supplier
Current Condition
Inventory Date
By
Maintenance Activity Reqd.
Maint. Date
Maint. Period
Service Record
Item Name
Description
Serial No:
Location
Warranty Period
Purchase Order #
Date Ordered
Date Received

Item Name Serial No: Purchase Order #
Description Date Ordered
Location Warranty Period
Date Received Cost Supplier
Inventory Date By Current Condition
Maintenance Activity Reqd. Maint. Period
Maint. Date Service Record

Environmental Considerations

- Specify by laboratory and auxiliary space
- Specify visual, auditory, air, utility, safety, handicapped access/accommodation, ventilation and structural requirements

Evaluation and Modification of Equipment and Facilities

Planning, evaluating and re-organizing should take place continually if an Industrial Technology/Technology Education laboratory is to remain an up-to-date environment for learning.

- Actively promote input from advisory councils, other colleagues, administrative personnel, industrial representatives, etc.
- Conduct annual facility evaluations and pay particular attention to educational goals
- Include students in the facility evaluation process

Funding Sources

In the state of Missouri the burden of facility construction and remodeling of elementary and secondary schools lies largely with local school districts. No general programs of federal financial support for school construction have been developed. However, the *Carl. D. Perkins Vocational Education Act of 1990* does provide the opportunity for Federal construction funds for occupational programs. The following are among the possible sources of funding:

- Pay as you go financing
- State aid, e.g., the ITE/TE grant awards program
- Federal aid
- The school's internal resources
- Industry partnerships
- Shared facilities with other depts.
- Non-tax revenue
- Bond issues
- Carl D. Perkins funds
- Special tax revenues (e.g., special video tax)
- Funding designated for special needs populations
- Private foundations (e.g., Kellogg, Danforth, Wal-Mart, etc.)
- Leasing of facilities/equipment
- Special grants

The Purchasing Process

The instructor must recognize that most major pieces of equipment, curriculum materials and software require cycling through a systematic purchase process. Usually this process involves:

- Securing purchase approval in principle.
- Developing detailed specifications for what is desired.
- Identifying alternative suppliers
- Securing specifications for desired equipment.
- Comparing supplier equipment to the desired specifications
- Developing a competitive bid in the form required by the school system
- Bidding the item.
- Selecting successful bidder.

- Securing final purchase approval.
- Ordering the item.
- Receiving the item.
- Installing and testing the item.
- Authorizing payment.

Budgeting

It is recommended that ITE/TE instructors work with their administrators to establish a budget for their program/course. In this way routine purchases can be expedited. However, long-range plans for the phased-in acquisition of equipment are needed to supplement the normal budget process. Typically such plans are used to achieve significant updating goals. They can also be used to attend to initial routine replacement process for worn-out/obsolete equipment, curriculum materials and software.

Donations

Instructors are well advised to make use of their industrial contacts and their ITE/TE program advisory councils, for purposes of securing donations to hardware and supplies. Often this is an overlooked component in the supply side of the picture. Additionally organizations such as those listed in Chapter V can also be helpful. Because of the typical laboratory's space restrictions, it is recommended that one not accept equipment that will not meet course objectives. Of course, the exception is when permission is granted to use such donations as "trading stock" to get other more appropriate items.

Writing Specifications[2]

Just as the architect uses a graphic language to communicate an idea to the client and to the contractors, the instructor uses specifications as a vehicle to convey his/her thoughts to the school's administration and to the companies who will supply the school's needs.

It is therefore important that the specifications be sufficiently clear so as to remove all doubt about the items being sought. The information given should solve two problems. It should state enough characteristics such as size, model number, brand, etc. so that the specific application of the item is evident. Secondly, it should be detailed enough to rule out all known items of lesser quality that could be substituted to achieve a lower bid price. The three major participants in the specifications development process are the instructor, the administrator/supervisor and the vendor.

The Role of the Instructor

Above all, it is vitally important that the instructor be familiar with the range of available equipment and suppliers. During the last few years there has been a tremendous increase in the type of equipment available to teach all facets of industrial technology and many new vendors have emerged. Existing vendors have also broadened their lines as well. All of this has made it increasingly difficult for instructors to oversee. Clearly the easiest way to develop the vitally needed overview so that the most effective purchasing can occur is for instructors to attend the trade shows at the national conferences (AVA & ITEA). A few days there are invariably more valuable than months of magazine scanning.

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[2] The MO ITE/TE Guide development tema appreciates the assistance of Mr. David H. Thompson, District Manager, Brodhead Garrett Co. in developing this section.

The instructor bears the majority of responsibility for accurate specifications in that they are generally originated by him/her and he/she alone knows what is really wanted as well as what could be substituted. Instructors should consider the following hints as a guide for writing successful specifications:

> **I it is vitally important that the instructor be familiar with the range of available equipment and suppliers.**

- State quantity (each, dozen, gross, etc).
- Give product or manufacturer number (Model 1920 USRK).
- Choose a recommended supplier and give their catalog number. Most companies assign an index or computer number for an accurate and immediate reference. Be sure the recommended company is reputable and that the catalog is current.
- Give manufacturer's description. This sets the standard of quality you expect.
- Give name of item. ("Bosch cordless electric drill" - not just "drill").
- Specify size, kind, particulars, etc. Example. 3/8 inch cordless electric drill, reversible, variable speed, etc.
- Describe accessories such as guards, blades, switches, guides, etc. Many of the items are sold separately so a supplier needs to know if they are expected to be included in the price that is to be quoted.
- State whether alternatives may be substituted if approved as equal.
- Specify type of delivery expected:
  - Dock delivery (tail gate)
  - Inside delivery
  - Installed (not connected)
  - Fully installed and operational. Installation is not available from all suppliers. Some will install for an added charge depending on the complexity of the job.
- State whether the shipping cost is to be included in the bid price. If unspecified this can become an expensive surprise for the school.
- It is important that the ITE/TE instructor establish and maintain credibility with his/her administration. Back up your request with supportive statements that show the need for the requisitioned item.
- Specify the services you expect with the product. For example: On-site service, shipping, delivery, installation, training, assistance in curriculum development, etc.
- Allow enough time for the request to be processed through the administration, and the bidding, ordering and delivery process.

The Role of the Administrator

Schools generally have a policy that requires the principal, business manager, or purchasing agent to review ITE/TE instructor requisitions before ordering. There are three reasons why a careful examination should be made:

- The request should be examined to see if it is "over-kill" or "under-kill" for the specific application for which it is to be purchased. This is in reference to size, quality and quantity. Some brands may be too light or too cheap to last while others may be too large for an educational application.
- The request should represent a best possible price for the product and/or service needed. Additional bids may need to be solicited to determine whether or not the best value has been identified.
- It is the administrator's duty to see that all school policies have been considered, i.e., school contracts with designated companies have to be honored, that orders are given to with good records of service, reliability and representation. Many Boards of Education encourage local purchasing when permissible to keep money in the community and/or to insure fast service.

The Role of the Supply Company (Vendor)

The responsibility of the supplier is two-fold:

- To meet the specifications which have been submitted with a product that will satisfy the requirement for minimum cost.
- To assist the school by giving them the maximum quality for the money they want to invest.

Vendors are in a position to see new trends, new products and new applications because of their various contacts with manufacturers and educational leaders. Therefore, occasionally a company or representative will offer a suggestion of an alternative which may be a better value than that requested, or a quality level more appropriate to the application. This of course, has to be in advance of a formal bid or as an alternative bid. ITE/TE instructors need to explore such opportunities when they arise.

Common Problems

Suppliers are often faced with problems on purchase requisitions. Requisitions should be carefully reviewed to be sure these problems do not apply:

- Name and address of the proposed supplier(s) is omitted.
- An old catalog is used for pricing for pricing and reference.
- A requisition is submitted rather than an official purchase order.
- The part number and/or stock number is omitted.
- School administration approval of the purchase is not evident.
- There is no clear policy at the school for receiving and signing for merchandise.
- Desired items are not adequately described.
- Electrical data omitted.
- Accessories for equipment omitted.

12. Maintaining Laboratory Equipment

Even the best facilities and equipment will surely deteriorate quickly if the instructor does not maintain them. Furthermore a lack of attention to maintenance sends a message to students and the problem quickly grows.

However, the positive side also works. Where it is obvious that the instructor cares about the laboratory, it is easy to instill a similar respect among the students. So, how does this occur? The following points are derived from the experience of many successful industrial arts/Industrial Technology/Technology Education teachers:

Even the best facilities and equipment will surely deteriorate quickly if the instructor does not maintain them.

1. Perform routine maintenance to prevent breakdowns.
   - Establish a preventative maintenance schedule for each machine
   - Enlist student help where it is safe and it contributes to goal achievement
2. Establish a file folder for each machine in the laboratory. This should include:
   - A data card
   - Manufacturer's information
   - Parts list and supplier's names (identify parts on hand and their location)
   - Maintenance (preventative and special) record
3. Develop a systematic facility shut-down procedure for the summer and startup procedure for the fall, e.g.,
   - Waxing machined surfaces to prevent rusting
   - Greasing and oiling machines
   - Releasing belt-drive tensions
   - Recharging fire extinguishers
   - Sharpening tools
4. Purchase maintenance contracts on large and complex technological equipment if, and only if, it is cost-effective. Otherwise negotiate an agreement with your administration to establish a self-insurance program whereby special maintenance costs do not come out of the ITE/TE budget. Point out the liability incurred by school systems when students work on equipment not in proper condition.
5. Establish a portable maintenance tool box and supply kit that can be quickly picked up and carried to where maintenance is required. This kit should be self-contained and include:
   - A complement of wrenches
   - Punches and chisels
   - Pliers and vise grips
   - Screwdriver set

- A sample of greases, oils and lubricants and applicators
- A portable drill and bits, extension cord
- Hard and soft-faced hammers
- A volt/amp meter
- A lock to lock out power and supply switches
- A set of hang tags to indicate problems/maintenance

6. Use hang tags to indicate machines with problems, e.g.:
   - Do not use
   - Under maintenance
   - Secure instructor permission before operating

7. Incorporate routine maintenance and inspections into the period, daily or weekly clean-up responsibility list.

8. Develop an equipment problem report form and show students how to use it.
9. Annually review the maintenance records to identify growing problems and develop replacement recommendations accordingly.

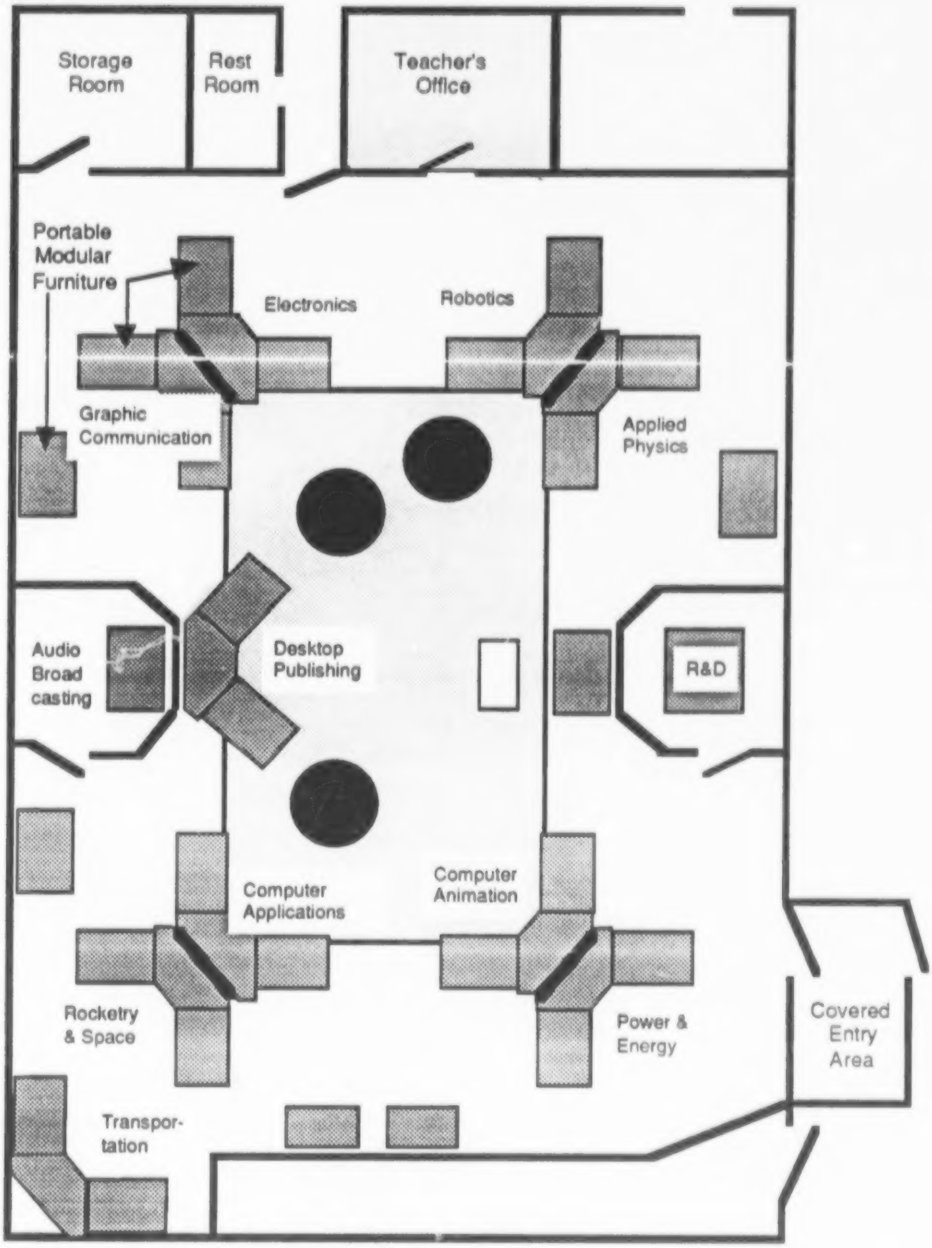
10. Prepare an annual maintenance report, listing time spent, cost, and activity during the year and submit it to the school administration.

11. Develop a collection of maintenance books and articles.

13. Sample Facility Designs

To stimulate the facility design process, a few sample designs from around the nation have been selected and shown in Figures III-20 through III-26. The first two depict one of the outstanding Industrial Technology/Technology Education facilities in the country, Delta Middle School and Paonia High School in Delta County Colorado. Figure III-22 presents the updated facility at the University of Utah.All could house Missouri's recommended ITE/TE program well. However, instructors should consider these plans **only** as sources of ideas, not as state recommendations. Additional facility planning details can be obtained from the documents listed in this chapter's part 8 (Resources).

Figure III-20
Delta Middle School
Delta, CO


Storage Room
Rest Room
Teacher's Office
Portable Modular Furniture
Electronics
Robotics
Graphic Communication
Applied Physics
Audio Broad casting
Desktop Publishing
R&D
Computer Applications
Computer Animation
Rocketry & Space
Power & Energy
Covered Entry Area
Transpor-tation

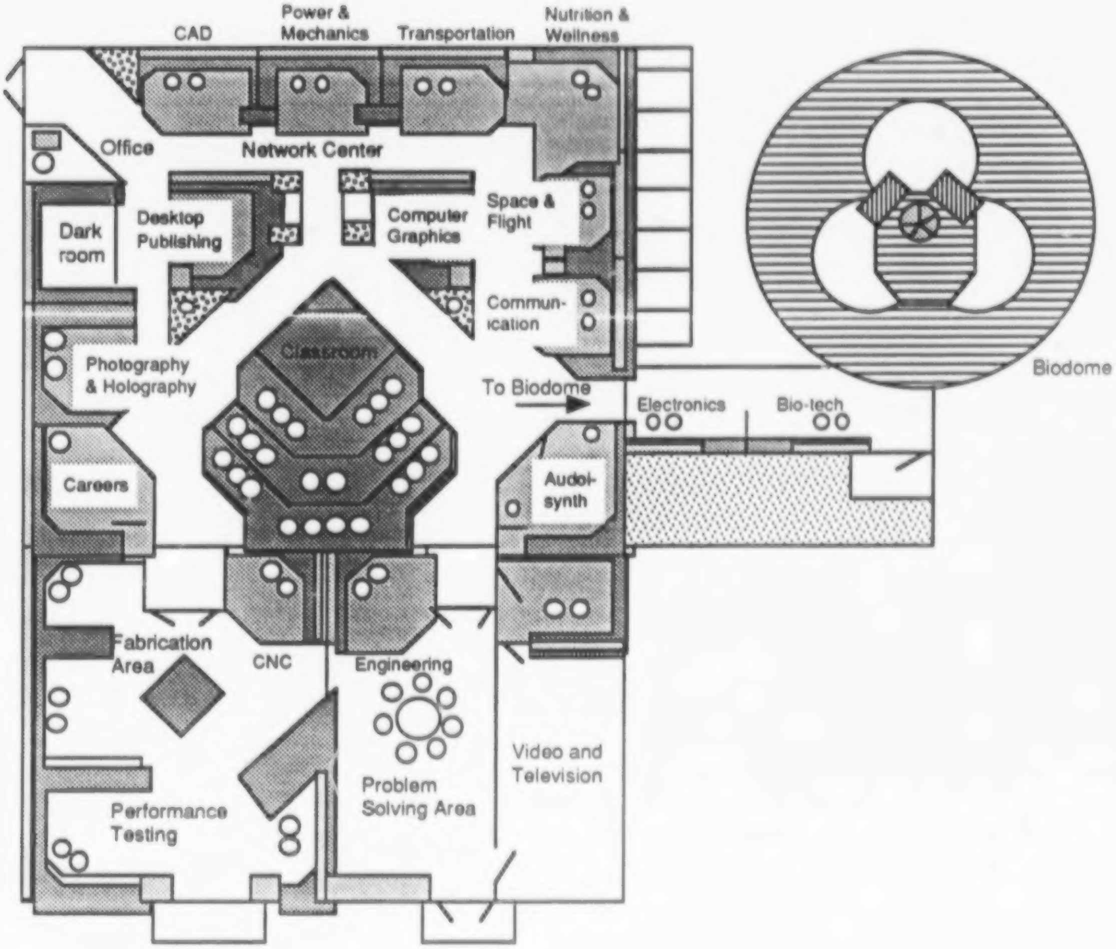
Overall Size: 38' x 61'

☐ Carpeted Areas

Courtesy of Michael Needen

Figure III-21

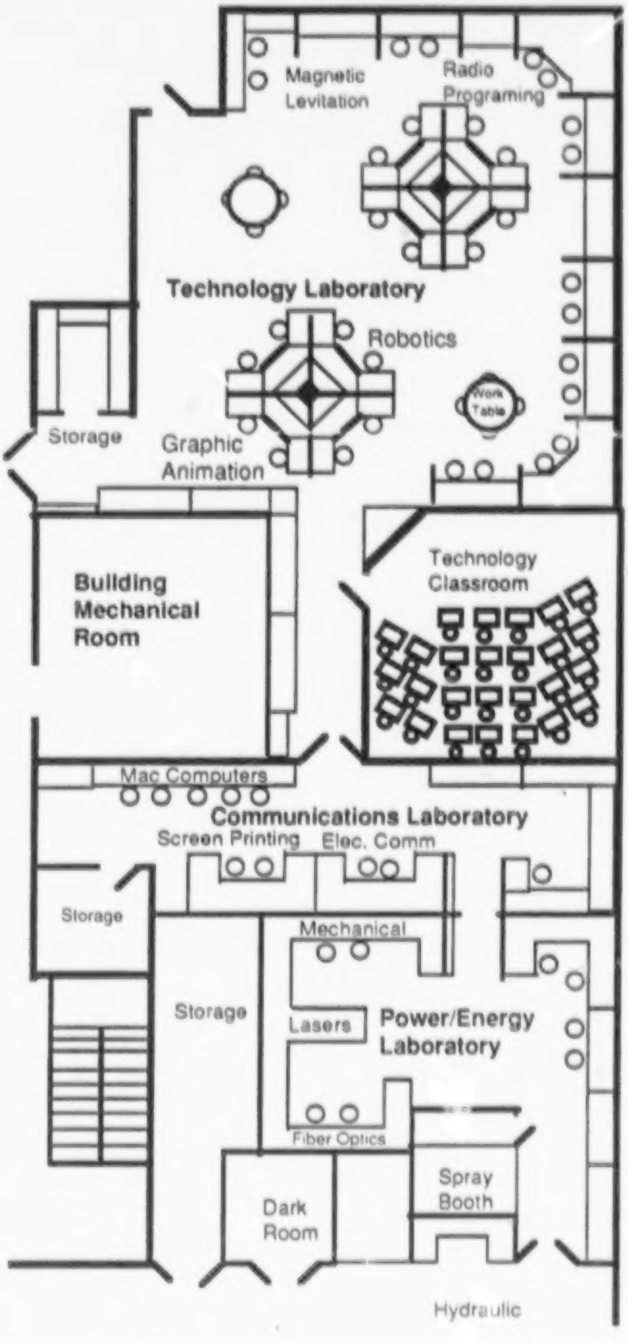
Paonia High School
Delta, CO


CAD
Power & Mechanics
Transportation
Nutrition & Wellness
Office
Network Center
Dark room
Desktop Publishing
Computer Graphics
Space & Flight
Commun-ication
Classroom
Photography & Holography
To Biodome
Biodome
Electronics
Bio-tech
Careers
Audoi-synth
Fabrication Area
CNC
Engineering
Problem Solving Area
Video and Television
Performance Testing

Courtesy of Michael Needen

Figure III-22

Industrial Technology/Technology Education Laboratory


Magnetic Levitation
Radio Programing
Technology Laboratory
Robotics
Work Table
Storage
Graphic Animation
Building Mechanical Room
Technology Classroom
Mac Computers
Communications Laboratory
Screen Printing
Elec. Comm
Storage
Mechanical
Storage
Lasers
Power/Energy Laboratory
Fiber Optics
Dark Room
Spray Booth
Hydraulic

Adapted from the University of Utah, Provo, Utah

Figure III-23

Wood River JHS, Hailey, Idaho

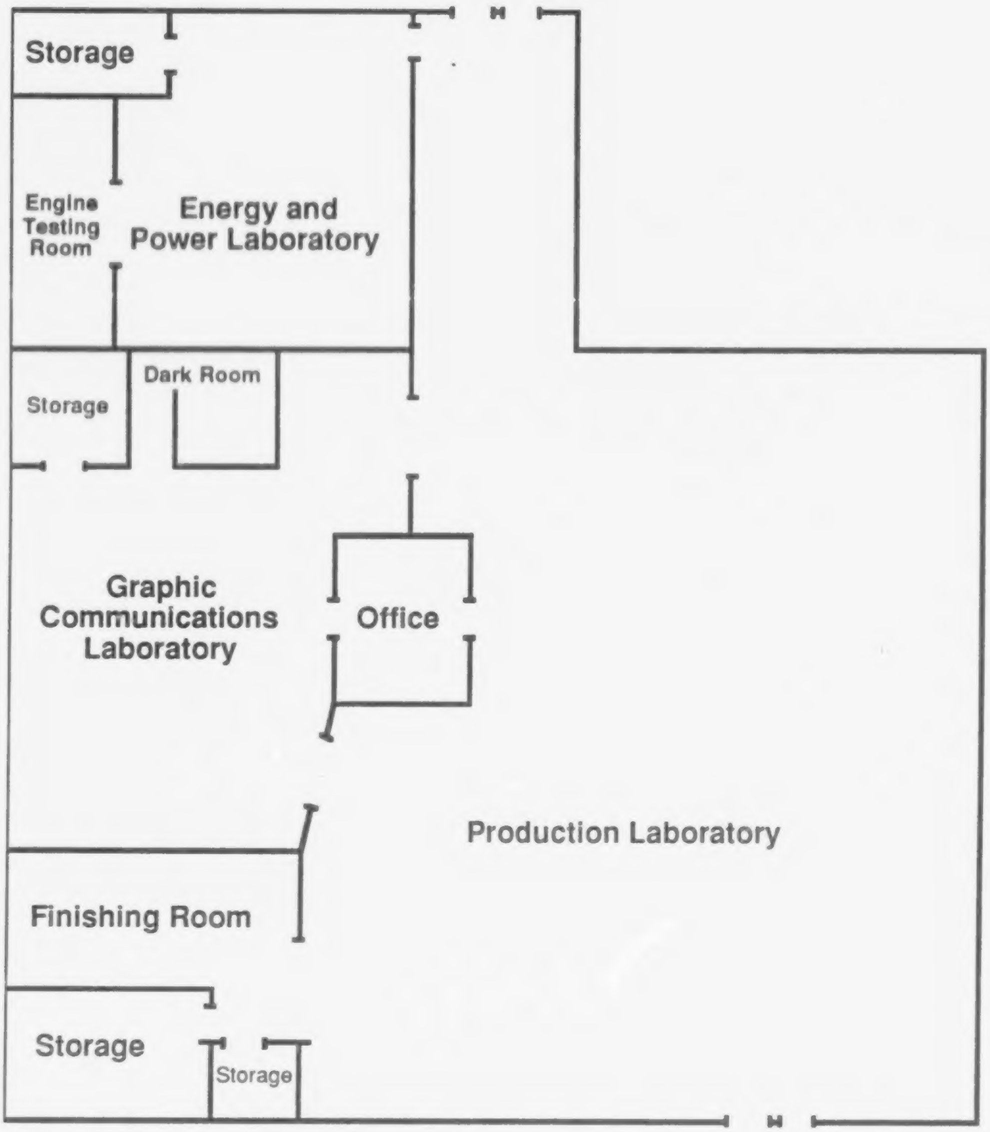
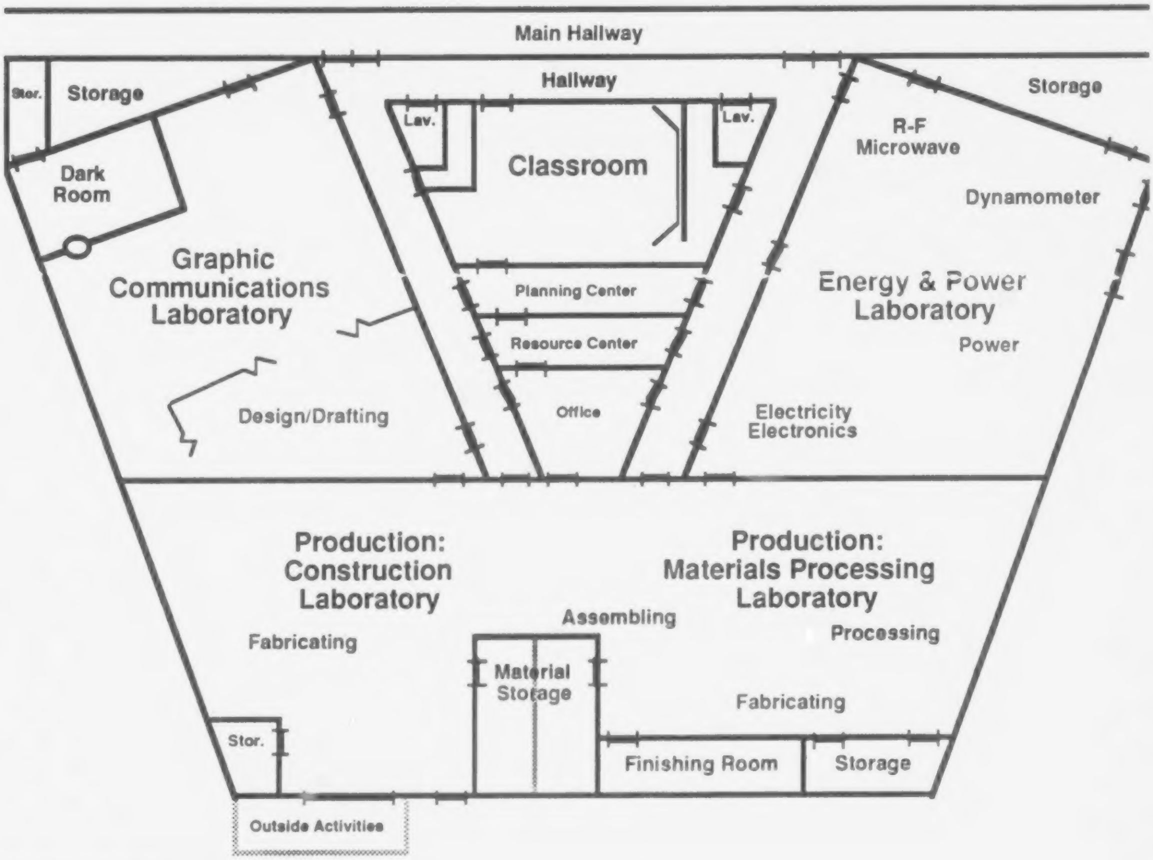

Storage
Engine Testing Room
Energy and Power Laboratory
Storage
Dark Room
Graphic Communications Laboratory
Office
Production Laboratory
Finishing Room
Storage
Storage

Figure III-24

Sample SHS ITE/TE Facility (North Dakota)[1]


Main Hallway
Stor.
Storage
Hallway
Lav.
Classroom
Lav.
Storage
R-F Microwave
Dark Room
Dynamometer
Graphic Communications Laboratory
Planning Center
Resource Center
Energy & Power Laboratory
Power
Office
Design/Drafting
Electricity Electronics
Production: Construction Laboratory
Production: Materials Processing Laboratory
Assembling
Fabricating
Processing
Material Storage
Fabricating
Stor.
Finishing Room
Storage
Outside Activities

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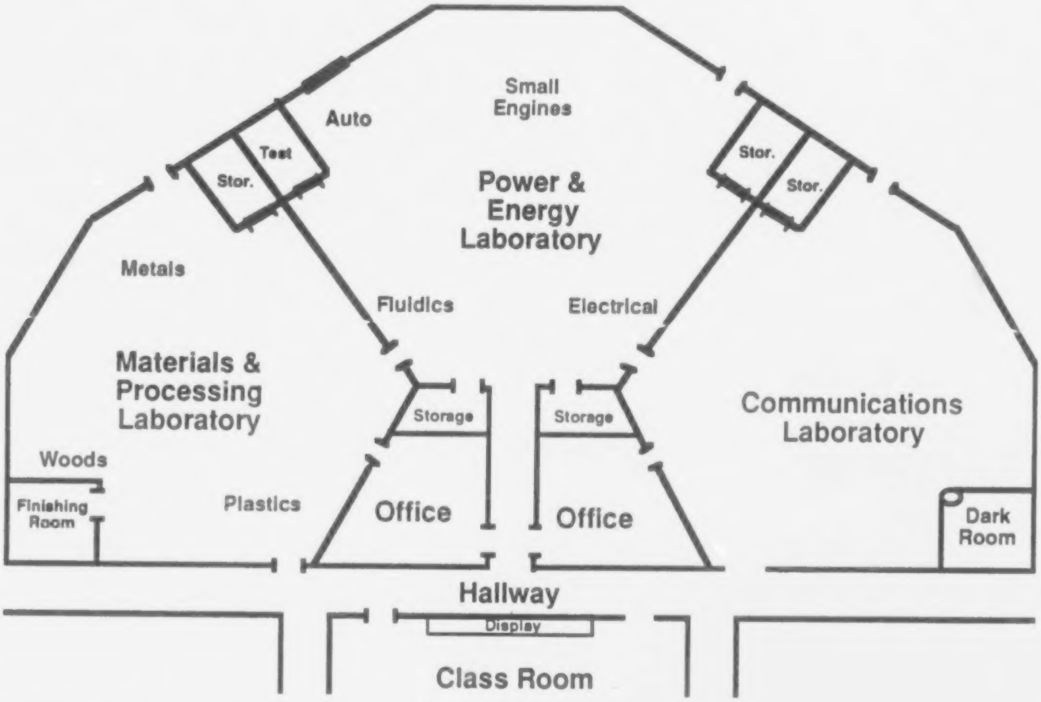
[1] Bender, 1978, p. 61.

Figure III-25

Sample SHS ITE/TE Facility -- Wedge shaped (Wisconsin)[1]


Small Engines
Auto
Test
Stor.
Stor.
Stor.
Power & Energy Laboratory
Metals
Fluidics
Electrical
Materials & Processing Laboratory
Storage
Storage
Communications Laboratory
Woods
Finishing Room
Plastics
Office
Office
Dark Room
Hallway
Display
Class Room

---

[1] Stallsmith, 1977.

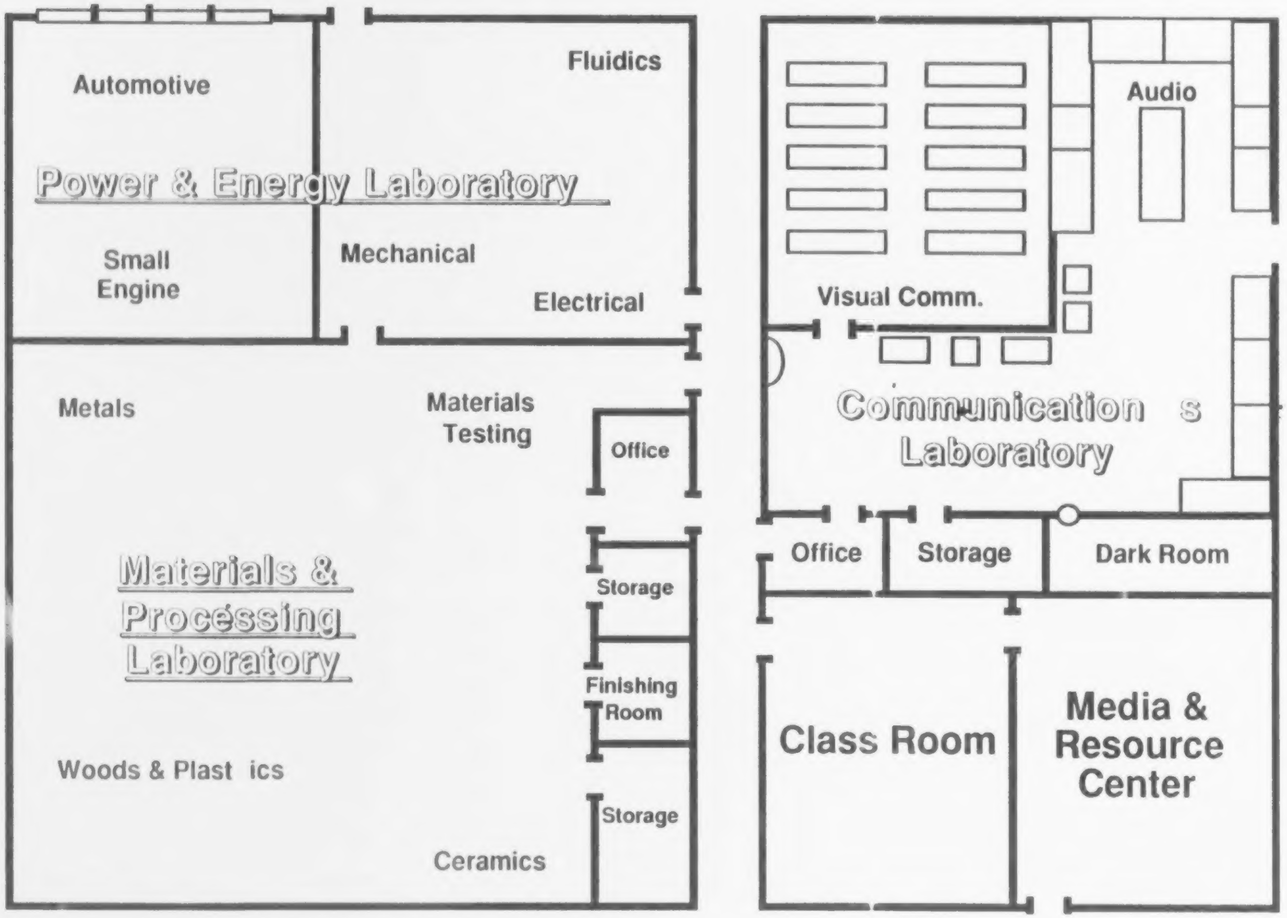
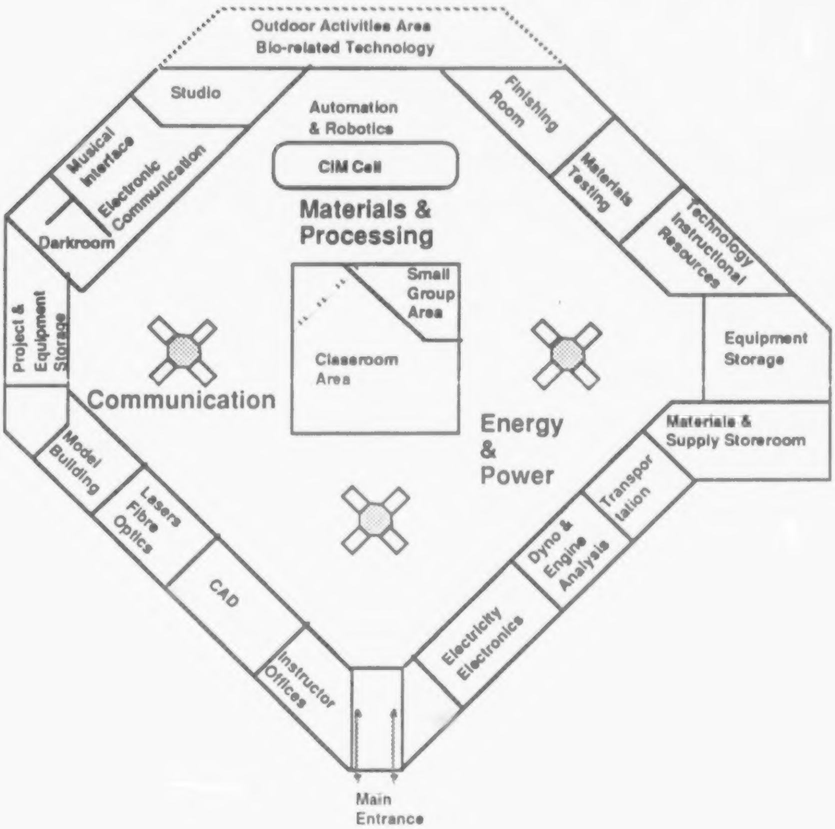

Automotive
Fluidics
Power & Energy Laboratory
Small Engine
Mechanical
Electrical
Audio
Visual Comm.
Metals
Materials Testing
Office
Communications Laboratory
Materials & Processing Laboratory
Storage
Office
Storage
Dark Room
Finishing Room
Class Room
Media & Resource Center
Woods & Plastics
Storage
Ceramics

Figure III-26
Sample SHS ITE/TE Facility – Rectangular

Figure III-27

Model Cluster-Based ITE/TE Facility


Outdoor Activities Area
Bio-related Technology
Studio
Musical Interface
Electronic Communication
Darkroom
Project & Equipment Storage
Automation & Robotics
CIM Cell
Materials & Processing
Small Group Area
Classroom Area
Communication
Energy & Power
Finishing Room
Materials Testing
Technology Instructional Resources
Equipment Storage
Materials & Supply Storeroom
Transportation
Dyno & Engine Analysis
Electricity Electronics
Model Building
Lasers Fibre Optics
CAD
Instructor Offices
Main Entrance

- Classroom area doubles as television studio
- Communication & Electricity/Electronics areas are pressurized with ventilation system to keep dust away
- Folding walls in classroom area provide flexibility
- Special project rooms are for R & D and Experimentation classes and advanced students
- Classroom walls equipped with double glass windows c/w internal blinds
- The facility is designed for three instructors conducting classes simultaneously
- Each technological cluster area contains enough space for simulation and enterprise activities.
- Laboratory equipment is envisioned as being portable
- Portable equipment, instructional dividers, chairs and whiteboards are located in storerooms
- Centrally located modules are moveable and reconfigurable

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Chapter IV

Implementing a Safety Program

IN CASE OF FIRE...

DANGER

WEAR PROTECTIVE EQUIPMENT

SAFETY FIRST

SAFETY RESPONSIBILITIES

RECORD KEEPING EMERGENCIES

Chapter IV

Implementing a Safety Program [1,2]

1. Introduction and Overview

Safety must be an ever present concern of all ITE/TE instructors. Given the hundreds of thousands of students who over the years have experienced TE/ITE, it is clear that this concern for safety has been attended to. However, safety is something that can never be taken for granted. This section presents some guidelines and recommendations that will help ITE/TE instructors in maintaining and increasing safety of their learning.

Chapter 4 Outline

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Overview

Whenever one deals with safety, the overall safety hierarchy must be kept in mind. In the business and industrial world this means that a situation is first engineered for safety; then remaining hazards are guarded against; education to prevent and avoid accidents is subsequently provided; and finally, personal protective equipment is supplied to further reduce vulnerability. Administrators and instructors are well advised to emulate this private sector practice by:

- specifying and securing only thoughtfully engineered safe machines, equipment and facilities
- guarding against existing hazards with systematically engineered devices
- incorporating a comprehensive safety instruction program into each course
- providing and requiring the use of necessary personal protective equipment, of appropriate design and quality, in sufficient quantity

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[1] The information and materials contained in this publication have been compiled from sources believed to be reliable and to represent the best current opinion on the subject. No warranty, guarantee or representation is made by the contractors, the State of Missouri, the Department of Elementary and Secondary Education, and/or any contributors to this document, as to the absolute correctness or sufficiency of any representation contained in this publication. The writers and contributors assume no responsibility in connection therewith; nor can it be assumed that all acceptable safety measures are contained in this publication, or that other additional measures may not be required under particular or exceptional conditions or circumstances.

[2] Much of the material in this section was extracted and/or adapted from Missouri's *Vocational Safety Guide*, Dyrenfurth & Linhardt, 1981.

However, any section as short as this one cannot adequately cover the complex topic of safety. For additional details, readers are encouraged to consult supplementary resources such as those listed in Part 12 of this chapter. Additionally, instructors are encouraged to consult experts, because safety is just too important a concern to be handled individually. The following personnel can provide additional detailed information:

- Missouri's State Industrial Technology Education Supervisor—This person, due to day-to-day involvement, can provide valuable advice on many safety-related matters.
- Specialized Resource Personnel—These are individuals who are teaching or otherwise specifically concerned with safety. Examples include: university, junior/community college and area vocational school faculty as well as representatives from agencies such as those listed in this Guide's association section.
- Industrial Consultants—Many industries already provide representatives to serve on advisory committees. These and other companies can often supply safety, facility, equipment and material advice.

Additionally, instructors are encouraged to consult experts, because safety is just too important a concern to be handled individually.

It is suggested that instructors begin work on safety with a thorough review of what they are currently doing. The Missouri ITE Standards' Topic 9, found in this Chapter's part 7, provides the most useful way of accomplishing this. The standards will guide a systematic review of the:

- ITE/TE Program
- Physical Environment
- Records

Then, for additional input, many of the referenced guides in this section's resource listing (Part 12) provide detailed answers to most of the specific questions instructors will ask.

Objectives of The Safety Chapter

The objectives of this safety chapter are to provide Missouri's industrial technology/technology education supervisors and instructors with:

1. A description of the legal and professional responsibilities pertaining directly to industrial technology/technology education, boards of education, administrators, teachers, students and parents.
2. An overview of the liability potential facing industrial technology/technology education programs and personnel and a list of recommendations to provide protection (i.e., minimize liability potential).
3. A set of safety program recommendations including sample forms, evaluation procedures, facility recommendations, equipment recommendations and suggestions for instruction.

4. A guide to assist instructors in developing world of work relevant safety attitudes, skills and knowledge in students.
5. A guide that supplements the Missouri Department of Secondary and Elementary Education's *Administrative guidelines for school safety* by addressing safety as it specifically applies to industrial technology/technology education.

2. Missouri Specifics

Each state presents a unique set of circumstances related to industrial technology/technology education safety. This section highlights those aspects unique to Missouri's situation. As such, this section includes mention of: state codes that specifically pertain to vocational safety, the applicability of OSHA regulations to Missouri's schools, and this chapter's relationship to the existing school safety guidelines.

Liability of the State

"It is a long-established principle of common law that the state is not liable in damages for injuries resulting from the negligence of its officers, agents and employees" (Garber & Delon, p. 115).

Liability of School Districts

"Because school districts are agencies or arms of the state it has been held that the immunity which clothes the state also clothes school districts and their administrative bodies—boards of education" (Garber & Delon, p. 115).

OSHA, Right to Know, and Missouri

Missouri does not have a federally approved state plan for safety and health; therefore, Missouri public schools are not subject to any direct safety and health regulation under OSHA. However, teachers are liable under common law should an accident or exposure to dangerous materials occur.

Missouri Eye Safety Law

Missouri has enacted a specific law governing eye protection (Missouri Revised Statutes, 1978. #170.005 Eye Protection—who affected; 170.007 Standards for Protective Devices; 170.009 Implementation of Eye Protection Act).

Good Samaritan Law

Missouri's revised statutes provide limited protection to persons trained to provide first aid by a standardized training program, to render (without compensation) emergency care or assistance to the level they have been trained.

Administrative Guidelines for School Safety

School personnel should note the document, *Administrative guidelines for school safety*, as prepared by Missouri's Department of Elementary and Secondary Education. This addresses general school aspects, school transportation safety planning and it provides a sample of Board of Education recommendations for safety education and emergency preparedness.

Missouri Hazardous Waste Management Law, Sections 260.350-260.433, RSMo[1]

Missouri regulations are as stringent, and in many cases more stringent, than federal regulations, and apply to all generators of hazardous waste. Any school generating or accumulating more than 1 kg (2.2 pounds) of hazardous wastes or more than 1 kg (2.2 pounds) of acutely hazardous wastes per month has been liable under the regulatory statutes of the Missouri Hazardous Waste Management Law. The *Code of Federal Regulations*, found in local libraries, contains lists of hazardous wastes (the "U" list) and of acutely hazardous wastes (the "P" list). Any solid, liquid, semi-solid, or contained gaseous material becomes a "waste" at the time it is discarded. If the regulated amount of waste is generated or accumulated in a calendar month or at any one time, the school must:

1. Identify the waste either by applying knowledge of the waste or by conducting laboratory analysis.
2. Register the waste with the Department of Natural Resources (DNR) using the form MO780-1164.
3. Store and label the hazardous waste according to regulation and meet safety standards.
4. Properly transport and dispose of hazardous waste within the storage time limits set by regulation. Storage time begins with the date of the first placement of waste in a container. A small-quantity generator such as a school has up to 180 days to store waste if the waste is shipped to a facility 200 miles or less from the school, or up to 270 days if the waste is shipped more than 200 miles for disposal.
5. Pay fees, taxes, and penalties, if applicable, on wastes which are generated.

Even if the school does not generate a regulated quantity of waste, the school must still identify its waste if the waste meets the criteria of being hazardous. Guidelines for transportation, management, and disposal, as suggested by the *Hazardous Waste Management Manual for Small-Quantity Generators* (DNR, Waste Management Program publication), should be followed. Small quantities of the waste may be sent to a local state-permitted sanitary landfill, though the landfill management has the right to reject any amount or type of hazardous waste. Some wastes may need special handling by the receiving solid-waste landfill and will require approval from the DNR prior to disposal. If in doubt about the acceptability of the waste or in need of special approval, consult the Waste Management Program of the DNR.

The school must still identify its waste if the waste meets the criteria of being hazardous.

Teachers should realize that mixing a hazardous waste with a non-hazardous waste will usually result in the entire volume being regulated as a hazardous waste. Dilution for the purpose of rendering waste non-hazardous is strictly forbidden—it is not a solution! A waste minimization approach as overviewed in the EPA *Waste Minimization* brochure would be wise to implement.

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[1] Lemmons, 1990, p. 25-26.

The Missouri Hazardous Waste Management Regulations are in Title 10, Division 25 of the *Code of State Regulations* adopted pursuant to Section 260.370 RSMo. This Code is available from the Secretary of State, Administrative Rules Division, P.O. Box 778, Jefferson City, MO 65102. The EPA conducts hazardous material workshops throughout the state. The Waste Management Program (314/751-3176) or the Laboratory Services Program (314/751-798) may also be contacted for more information.

Superfund Amendments and Reauthorization Act (SARA) of 1986[1]

Emergency Planning and Community Right-to-Know regulations contain provisions which pertain to public and private schools.

- Sections 301-303 require any facility having any of the Extremely Hazardous Substances in amounts above the threshold planning quantity (TPQ) on its premises to notify the Local Emergency Planning Committee (LEPC) and the State Emergency Response Commission (SERC) that the facility is subject to the planning provisions and should be included in the local response plan. For example, if a school has a swimming pool and stores over 100 pounds of chlorine at any time, the school will need to follow the planning requirements.
- Section 304 deals with reporting accidental spills or release of chemicals to the local committee, state commission and National Response Center. There are over 700 hazardous substances subject to reporting, with the reportable spill quantity starting at one pound for some chemicals.
- Sections 311-312 are the Community Right-to-Know portions of this act. Schools must have available Material Safety Data Sheets (MSDS) and submit information about inventories and the location of chemicals on their premises for which MSDS exist to the LEPC, the SERC, and the local fire department. Under section 311, copies of the MSDS or a list of chemicals must be provided; under section 312, a Tier II inventory form of the same chemicals must be submitted annually by March 1 to the LEPC, SERC, and fire department. MSDS are available upon request from suppliers of chemicals, and are the best source of information regarding hazards and toxicity, first aid treatment accident response, and storage for the substance. Even though not required, it would be helpful for all schools to supply the local fire department with an inventory of all hazardous chemicals in case of a fire emergency.

All schools should supply the local fire department with an inventory of all hazardous chemicals in case of a fire emergency.

For a list of the substances subject to reporting or for more information, contact one of the following:

EPA—Region VII
726 Minnesota Avenue
Kansas City KS 66101
(913) 236-2806

National SARA hotline:
1-800-535-0202

Missouri Emergency Response Commission
Department of Natural Resources
P.O. Box 3133
Jefferson City MO 65102
(314) 751-7929

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[1] Lemmons, 1990, p. 26-27.

3. Safety Responsibilities[1]

In order for safety to work and be taught effectively, a consistent system-wide implementation must be present. This necessarily requires the active and planned cooperation of the system's entire team, consisting of but not limited to: the school board, the superintendent, district safety coordinator, school facility personnel, school safety committee, the principal, school building safety coordinator, the industrial technology/technology education teacher(s), the students and the parents. Note that in some districts, these responsibilities may be organized differently—but they still remain matters that require systematic attention. Some key highlights of such responsibilities are listed in the following subsections.

Local Board of Education Responsibilities

1. Be aware of and consider safety and emergency disaster planning when reviewing school construction specifications.
2. Establish a policy statement including school safety and personnel assignments and responsibilities in the area of industrial technology/technology education safety.
3. Comply with competent legal and expert advice concerning safety, school personnel and school property, instruction, safety programs, emergencies, drills and exercises.
4. Provide efficient, effective and safe industrial technology/technology education and vocational technical education facilities and equipment and funds, sufficient and necessary maintenance and improvements, facility projects, safety supplies and equipment to produce a safe instructional environment.
5. Provide liability insurance and legal services to employees as commensurate with law and/or agreements and inform industrial technology/technology education instructors of any specific insurance coverage arranged through district policies.
6. Require that the industrial technology/technology education and vocational technical education curriculum devote sufficient time for safety instruction and provide for the safety of students when innovations involving curriculum changes are made.
7. Evaluate performance of district and school administration and teachers regarding safety procedures, equipment and safety instruction quality, and provide for inspection and enforcement of established safety regulations.
8. Incorporate a safety review as an integral part of the design and approval of new and/or remodeled facilities.
9. Appoint a safety coordinator for the school district and adopt a job description that includes industrial technology/technology education safety responsibilities.
10. Provide and/or support in-service training of industrial technology/technology education teachers in the area of safety.

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[1] Additional details available in the Missouri's *Administrative guidelines for school safety.*

11. Regularly inform administrators and instructional staff of their legal safety obligations and of any relevant changes.
12. Approve and/or revise the industrial technology/technology education safety program as advanced by faculty and administration.

Superintendent Responsibilities

1. Select and appoint a safety advisory committee.
2. Provide for the overall administration, budgeting, development, organization, personnel assignment, evaluation, updating and financial support of the school's ITE/TE safety program.
3. Appoint a director of safety or assign such overall responsibility to one person.
4. Implement an accident reporting system to establish data for improvement of administrative, instructional and protective measures.
5. Work towards ongoing school and community interest in safety.
6. Request sufficient and necessary improvements, facility maintenance projects, safety supplies and equipment to produce a safe instructional environment for industrial technology/technology education.
7. Insure that the industrial technology/technology education curricula devote sufficient time for safety instruction.
8. Develop emergency plans and procedures.

District Safety Coordinator and/or School Safety Committee and/or Building Safety Coordinator Responsibilities

1. Establish, guide and provide assistance to school safety committees.
2. Provide for and participate in school safety inspections of facilities, equipment, and programs per fire and insurance regulations.
3. Establish a communication system to keep teachers and administrators abreast of new safety standards and procedures.
4. Research special safety problems that may exist and conduct investigations of accidents.
5. Obtain, prepare, evaluate and disseminate safety-relevant material (laws, regulations, policies guidelines, inspection checklist, posters, curriculum items).
6. Report, record and analyze all accidents and regularly provide summaries to administration and faculty and make appropriate recommendations.
7. Supervise or cooperate with subject matter supervisors and instructors in the safety training of students.
8. Maintain professional contacts outside the school environment to exchange information with others and to keep the accident prevention and safety instruction program current.
9. Insure that federal, state, or local laws, ordinances, regulations and codes bearing on safety are complied with.
10. Initiate and continue activities that stimulate and maintain teacher and student interest in accident prevention. Assist in the incorporation of safety into all courses of study.

11. Implement, supervise and evaluate appropriate safety education programs, including curriculum, instruction, or staff improvement courses or seminars and request/provide for the training of all building personnel in emergency procedures and in-service safety workshops.
12. Promote first aid, CPR and related training for industrial technology/technology education faculty.
13. Coordinate the safety plans and educational activities for his/her school with those of other administrators, curricula and/or schools in the system and interact constructively with others involved in safety.

Principal's Responsibilities

1. Plan and disseminate safety program information to staff, students, parents and other district personnel.
2. Recommend and/or appoint a building safety coordinator and school nurse, as well as other building level safety personnel as appropriate.
3. Secure support from and maintain liaison with system administration with respect to:
    a. the approval of the overall safety education program.
    b. securing adequate budgetary support for safety items and activities.
    c. expediting building changes necessary for safe operation.
    d. procuring safety equipment.
    e. reporting and investigating accidents.
    f. selecting instructors with specific knowledge and ability to establish safe practices, procedures and environments.
    g. arranging for administrative measures that reduce liability of staff members
4. Provide positive leadership for an active and continuous school safety program and foster incorporation of safety education as part of the educational program by:
    a. initiating and supervising a specific program of overall school safety and instruction.
    b. promoting school-wide attitudes toward accident prevention.
    c. establishing in-service training in accident prevention for teachers.
    d. encouraging staff to maintain first aid proficiency.
    e. requiring that safety supplies and emergency procedures are current and properly organized.
    f. encouraging the instructional staff to be knowledgeable and proficient in the use of fire and other emergency apparatus.
    g. enforcing of accepted safety practices.
5. Implement the safety program by:
    a. checking periodically to insure the adopted safety program is in effect and reviewing the curriculum for the inclusion of safety instruction.
    b. observing teachers for implementation of safety instruction as an integral part of the course of study.
    c. stimulating the discovery, analysis and prompt correction of unsafe conditions or practices.
    d. supporting teachers in enforcement of safety regulations.
    e. reviewing accident reports.
    f. establishing procedures for investigating and analyzing accidents.
6. Provide safe facilities and services by:
    a. reporting unsafe facility conditions to higher authority.

   b. planning with teachers for the removal of unsafe facility conditions and other hazards and for the installation of safety devices.
   c. inspecting facilities regularly for condition of equipment and safety devices, proper housekeeping and adequacy of exits, ventilation and material handling systems.
   d. requiring that safety and applicable safety regulations are regularly reviewed.
   e. providing class sizes that are in keeping with student characteristics as well as the capacity, square footage and number of work stations available in each facility.
   f. providing a procedure for the removal of students who repeatedly violate established safety rules and regulations and who are identified as safety hazards.

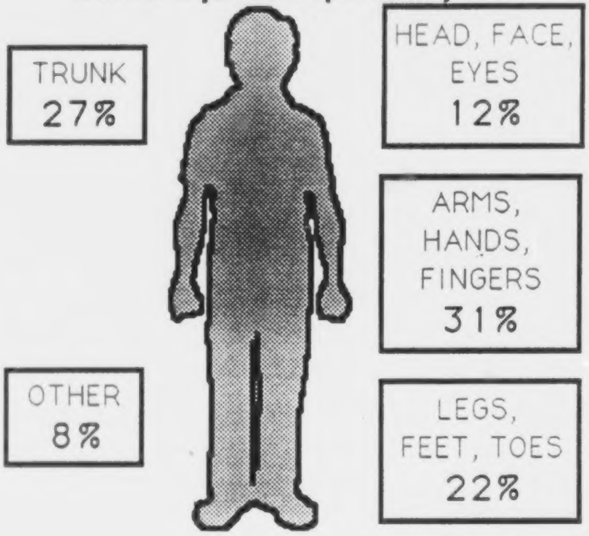
7. Maintain contact with and secure cooperation of outside personnel and local, state and national agencies which provide safety information and services by:
   a. assisting teachers in locating community personnel and services which will be helpful in the safety program.
   b. encouraging resource personnel to assist in the school's industrial technology/technology education safety program.
   c. regularly informing the public about the school's safety education program.

Teacher Responsibilities

1. Comply with safety policies and regulations and systematically implement the approved safety program including:
   - fire precautions
   - electrical safety
   - emergency procedures
   - hazardous materials
   - industrial standards (unless schools are more stringent)
2. Always provide for the supervision of students in the classroom or laboratory in accordance with legal requirements. Do not leave the classroom and/or laboratory unsupervised at any time when students are present or when they might enter in your absence.

Figure IV-1

Worker Injuries Reported by NSC



Jacobs et al., 1981

3. Motivate students to strive for safety by setting a good personal example for the students by observing all safety rules and practices.
4. Perform all instructional responsibilities in a manner commensurate with that of a reasonable, prudent person dealing with naive learners.
5. Establish course- and assist with facility-specific emergency procedures.
6. Enforce all safety and housekeeping rules and regulations.
7. Properly plan, arrange, clean and maintain the ITE/TE facility and equipment.
8. Provide prompt and thorough reports of accidents including written reports by instructor, written accounts by witnesses, photographs of accident scenes and conditions, and the standard accident report form.

9. Require that students receive the required safety instruction prior to working in the laboratory. Give instruction on potential hazards and accident prevention specific to the particular laboratory and course of study involved and incorporate safety instruction and testing (dealing with the proper use of all tools, machines, equipment and materials) in the formal course of study. Typically 100% is considered the proper criterion for mastery.
10. Be aware of the specific safety needs of special needs (disadvantaged and handicapped) students.
11. Actively cooperate and participate in all possible phases of the school and system's overall safety program.
12. Evaluate student teachers with specific regard to providing for their classes' safety.
13. Insist that guards meeting accepted standards be provided and used whenever a machine is operated. Insist that adequate eye protection be worn (during laboratory operation and in other potentially hazardous areas). Provide proper protective equipment and insist on its use, in all shop areas. Require students to wear proper clothing and adequate hair protection while working in the laboratory. Regularly inspect laboratory facilities and equipment to provide for optimum safety conditions by giving special attention to:
    a. layout of equipment and furniture.
    b. utilities and building services.
    c. equipment guarding.
    d. storage and condition of tools.
    e. storage, labeling, handling and condition of materials.
    f. personal protective equipment.
    g. emergency equipment and supplies.
    h. reporting results to administration.
14. Correct and/or report unsafe conditions and recommend needed safety improvements to the school's administration.
15. Develop specific safe practices, rules and regulations relating to your facilities and provide for their enforcement.
16. Insure that all course activities are in the school's approved course of study.
17. Record each student's attendance, safety instruction received and his/her safety evaluation results.
18. Periodically retest students to insure maintenance/retention of specific safety competencies.
19. Maintain current awareness of all types of safety, emergency and disaster procedures, developments and information.
20. Participate in safety training programs, such as first aid, civil defense and other relevant safety courses.
21. Request, maintain and check school safety supplies, materials and equipment.

Teachers Must:

- **Prevent**
- **Motivate**
- **Instruct**
- **Protect**
- **Document**

22. Locate and chart all valves, switches and lines of all utility services. Distribute these charts to all administrative and safety personnel and, where appropriate, to ITE/TE faculty.
23. Label in accordance with approved color coding all water, steam, gas and other tubular conduits and indicate with numerous arrows the normal direction of flow of fluids, within the ITE/TE facility.
24. Inspect and maintain protective equipment and emergency facilities including items within industrial technology/technology education laboratories and shops.

4. Liability & Negligence[1]

Instructor Liability

All too often articles and presentations about tort liability overemphasize grievous injuries that have been sustained by students and the expected huge court-awarded damages that have followed such injuries. Fisher, Schimmel, & Kelly (1981, p. 57) addressed this penchant when they wrote, "the result (of this emphasis) is to portray the law as an ubiquitous monster hiding in every educational shadow and ready to ensnare every innocent teacher. The monster is called a 'tort,' and the accompanying fear is of 'liability'." But, this dragon, unlike others, is easily slain. The required weapons within every teacher's grasp are called planning ahead, common sense, reason and prudence (meaning a tendency to err in the safe, conservative manner).

Let's look at this situation, often overblown and accompanied by media brouhaha, in a rational manner. If an injury would occur in a classroom or in the laboratory, what do the courts commonly look for? First, the courts ask, "Is there a duty owed?" And the answer to that is yes. Next the courts would want to know the standard of care that was provided. Three areas determine the standard of care in education. A teacher owes his/her students **active instruction** regarding their conduct and safety in the classroom, adequate supervision and consideration of potential hazards. Merely posting rules in a classroom is not enough. The common practice in vocational technical education of instructing students on safety rules and requiring that they pass tests on this material makes good instructional and legal sense; it is a practice recommended for educators in every grade and subject.

Regarding the adequacy of supervision, some suggest this actually means supervision. However, it is more important for teachers to remember that their watchful care of students should be judged by the students' maturity, size, age, mental capacity and the nature of the activity in which they are engaged. In general, the younger and more immature or handicapped the student, the more supervision is required. Similarly, the more potentially hazardous the activity, the more supervision is required (Hudgens & Vacca, 1985).

Vocational-technical educators face a difficult problem when they consider the potential hazard of an activity because juries and attorneys usually hold the subjective impression that the areas of physical education, laboratory sciences (e.g., chemistry) and vocational-technical education are the most hazardous. When this consideration is coupled with the federal mandates to include physically handicapped and mentally impaired individuals into all programs, including vocational-technical education, the educator's duty to supervise becomes demanding and difficult. Broward County, Florida, has concluded lengthy hearings to settle a dispute between the administration and faculty of a vocational technical high school and the parents of a blind student who wished to enroll in auto repair and welding. Safety for the student prevailed in this situation.

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[1] Because of its important content, this article was selected for inclusion in this safety chapter. It is as valid for TE/ITE as it is for VTE. Tort Liability in Vocational-Technical Education: How To Avoid It. Vos, R. & Pell, S. W. J. (1988). *Journal of Epsilon Pi Tau, 14*(2), pp. 24-28.

How can teachers assess variables such as maturity, size, age, mental capacity of students and the nature of activities? One answer is that the professional vocational technical educator should use common sense and if he or she is to err, let it be on the watchful, conservative side...

Also critical to the standard of care, especially in vocational-technical education, is the mandate to maintain a safe place, although the major responsibility for providing a safe environment rests with the school board. Hazardous or unsafe conditions are most easily identified by the instructors, who are part of the daily activity. They must communicate defects in equipment, hazardous facilities and any unsafe conditions to the administrators. These administrators, in turn, present such response to the school board. Documentation of teachers who meet this standard of care protects them if students would injure themselves while in the care of these teachers.

Nolte (1983) summarized an instructor's proper actions:

1. Inspect the instructional area frequently. Note hazards or potential hazards, such as nails, obstructions, lack of safety equipment and the like. Report hazards properly. Keep a copy of your report.
2. Instruct students about known hazards and warn them of possible dangers.
3. Report to administration all defective equipment. Shut down defective equipment.
4. Choose vantage points from which you can see all students engaged in any activity. Move from point to point.
5. Secure a supply of first-aid materials in case they are needed.

Finally, the courts would ask: "Was there a breach in the duty owed which caused an injury to a student?" The breach in standard of care can be characterized as either an error of commission (doing something by mistake, in error, or with willful and wanton malice) or as an error of omission (failing to do something one should). Examples of errors of commission would be: (a) continuing to operate broken or unsafe equipment, (b) allowing students to use machines or equipment without proper safety guards, (c) allowing students to work without an instructor present and (d) delegating supervisory duties to someone less qualified than the instructor. Examples of errors of omission would be: (a) failing to report and shut down broken or hazardous equipment, (b) failing to instruct students about safety rules and possible hazards, (c) failing to ascertain the physical and mental capacity of each student, (d) failing to break up fights or scuffles between students, (e) leaving students unsupervised, or if needed, failing to apply appropriate first aid.

Teacher Vulnerability[1]

It is important to remember teachers are not protected by an invisible shield from tort liability. Simply working for a public agency in a state in which governmental immunity has been abrogated and "save harmless" statutes have been enacted, does not relieve vocational-technical educators from liability and does not prevent the injured party from collecting damages. Educators should assess what their practices and attitudes are toward safety and what their possible exposures are to litigation.

...

Negligence[2]

Negligence cases always involve accusations of fault and proof of pain and suffering. No liability for negligence can be created unless there is proof of causation. Thomas (1978, p. 51) defined negligence as: "The doing of that thing which a reasonable prudent person would not have done, or the failure to do that thing which a reasonable prudent person would have done in like or similar circumstances." The vocational educator will not be liable for negligence if he or she can be said to have acted properly within the scope of his or her employment.

...

Below is a list of the possible defenses that teachers could use against charges of negligence:

1. It can be claimed that the standard of care was adequate and that reasonable prudence and foresight was exercised...
2. It can be demonstrated that the teacher actively instructed safety rules and routinely inspected the work area and equipment for hazards.
3. It can be claimed that students acted so quickly, unexpectedly, recklessly, or carelessly that they contributed to their own injury.
4. It can be contended that students could know and appreciate obvious dangers, such as how hot molten lead is.
5. Rarely, but significantly, teachers can claim "An Act of God."

...

Because most states have waived common law immunity, the school board usually is named as defendant in a suit, unless the teacher is suspected of negligence. In order to mitigate the risk of liability to provide a safe environment, teachers should follow the guidelines identified by Beckham (1982, p. 9):

1. Follow accepted policies of the school board.
2. Establish and maintain safety policies and procedures in the classroom and workplace.
3. Regularly inspect the workplace and equipment for defects or potential hazards.
4. Take steps to identify and foresee possible risks to students and take precautions to eliminate or minimize those risks.
5. Consider age, maturity, skill and ability of students when providing instruction and supervision.
6. Instruct students in safety procedures and guide their use of equipment with an emphasis on safety.
7. Place regard for human safety and recognition of prohibitively dangerous conditions foremost in your planning and execution of classroom or lab activities.
8. When in doubt, consult those colleagues and authorities in the field

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[1] Editor's note

[2] Editor's note

> whose experience and training can be helpful in advising on the proper standard of conduct to be adopted...

Although accidents may be inevitable in the vocational-technical education laboratory, if teachers know what contributing factors there could be, this could help to reduce both the number and severity of such accidents. Usually, such accidents can be attributed to one or more of the following: inadequate safety knowledge, poor safety attitudes and insufficient safety skills (Brownrigg, 1977). Ultimately, each of these factors is the responsibility of the teacher. It is his or her responsibility to assure that students acquire the proper safety knowledge, develop positive attitudes about safety and have the opportunity to develop the necessary safety.

Developing a sound safety education program can be the first step toward preventing accidents and, thereby, avoiding negligence suits. A complete safety program includes: (a) written rules and policies, (b) demonstrations of safe practices, (c) testing and questioning students to assess their levels of understanding (reteaching if warranted), and (d) observing students demonstrating safe practices. See this chapter's safety program organization and approval section Part 11).

It is a good practice for teachers to maintain copies of students' safety tests, records of students' performance on these tests, safety pledges signed by students and other information pertaining to their safety education programs. A teacher must never take for granted that students know or remember safety rules or practices.

Guidelines for Enforcing Safety Rules and Disciplines

Teachers must make certain that all safety rules are obeyed by students. The following guidelines can be used when teachers enforce safety rules:

1. Do not overlook any violation of a safety practice, no matter how minor.
2. Continuously reinforce and review safety practices. Safety is not taught in one lesson at the beginning of the year, but rather, it is taught throughout the year.
3. Set a proper example by observing all safety practices. Don't take short cuts. Students are less skilled, yet may believe they know it all and follow such an example.
4. Fully explain the safety rules used in the laboratory and what the consequence of noncompliance will be.
5. Establish, post and teach the safety discipline policy and insure that corrective procedures are known and consistently enforced.

If teachers observe these guidelines, it will make it easier for students to comply with safety rules and to let them know that safety is serious business (See also Kigin, 1975; Stern & Gathercoal, 1984.)

Conclusion-Liability Vulnerability

Following these guidelines will not keep vocational technical educators from being involved in a lawsuit, but it may protect them against a possible judgment of negligence. This paper provides 'how-to-do-it' guidelines based on a teacher's developing a sound safety program of foresight and prudence for avoiding litigation. Vigilant supervision of students and their activities is required. It is essential that technology educators maintain a safe work and study environment for students. Although this common-sense approach may, at first, seem difficult and time-consuming, properly conceived and exercised programs on safety are easier in the long run than court actions.

Figure IV-2

A Checklist for Liability Vulnerability[1]

To see how vulnerable one is, answer the following items honestly. **If the statement. "I don't..."** (read each numbered item here) **is true**, place a √ in the box ahead of the statement, otherwise just leave it blank.

☐ 1. Establish clear and comprehensive safety rules.
☐ 2. Base these rules on high safety standards and anticipated events, such as student behavior.
☐ 3. Actively demonstrate and teach the safety rules.
☐ 4. Inspect the classroom, other instructional areas and all equipment.
☐ 5. Report, in writing, all hazards to administrators and shut down defective equipment.
☐ 6. Identify potentially dangerous activities, use foresight in your classroom.
☐ 7. Base supervisory practices on a worst-case scenario.
☐ 8. Have contingency plans if something unexpected happens (e.g., you are called out of the room, you become ill in class, an injury occurs).
☐ 9. Assess the physical and mental capability of each student and gauge this against the activities you require.
☐ 10. Exercise consistently reasonable foresight overall.
☐ 11. Administer safety tests to students.
☐ 12. Effectively administer a comprehensive eye safety program.
☐ 13. Keep accurate written reports relative to accidents.
☐ 14. Permit students to use dull blade and/or cutting devices on hand tools.
☐ 15. Permit students to perform operations on machines without guards, particularly when one could have been used.
☐ 16. Allow use of equipment by students who are careless and/or who possess physical abnormalities that may cause an accident.
☐ 17. Permit students not enrolled in the class to use laboratory and tools.
☐ 18. Allow pupils to use equipment in the laboratory which has not been approved by the administration and board of education.
☐ 19. Permit students to work in the laboratory during free periods, particularly when the laboratory is not supervised.
☐ 20. Disconnect electric cords by pulling on the cords rather than on the plug.
☐ 21. Use metal ladders while working on electrical equipment.
☐ 22. Label switch panels and boxes and all potential hazards.
☐ 23. Have knowledge of the dangers of electricity or of electrical safety.
☐ 24. Maintain machines irregularly.

If any boxes are checked at all, you are vulnerable. If more than five are checked then there are serious problems that are probably indicative of a dangerous situation.

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[1] Compiled from Pryor (1984), Vos & Pell (1988) and others.

Protection From Litigation[1]

The instructor has the legal responsibility for accidents that involve students while they are participating in activities to which they have been assigned. Instructors may be held liable for accidents that happen as a result of their negligence and this liability may also extend to administrators. The reduction of, or protection from, liability may be helped by systematically incorporating the following points and others appropriate to the local situation into a coherent safety plan as follows:

1. Obtain adequate liability insurance from the International Technology Education Association, the American Vocational Association, the education association in your state, or other appropriate sources.
2. Provide adequate supervision and be in the classroom or laboratory at all times when class is in session.
3. Act as a reasonable and prudent person would act under the same or similar circumstances.
4. Correct known dangerous and defective conditions and/or report them to the proper authority and clearly mark them out of order or dangerous.
5. Use good sense in the selection of student activities.
6. Insist that safety glasses be worn in all areas in which there is equipment and even a remote chance of eye injury.
7. Provide proper instruction in the use of all tools, machines and equipment, including proper instruction as to the necessity, functions, use and adjustment of guards and personal protective equipment.
8. Organize and implement a comprehensive safety program, including systematic instruction, and rigidly enforce all rules and regulations.
9. Maintain the entire facility in safe working condition and periodically inspect all tools and machines.
10. Provide proper personal protective equipment and require students to wear it and proper clothing while working in the laboratory.
11. Clearly label toxic and flammable materials and provide proper storage for them.
12. Insist that industrial quality guards be provided and used whenever a machine is operated.
13. Know your students' strengths and weaknesses. Don't assume that students will perform in a safe manner.
14. Review safety policies and procedures on a regular schedule.
15. Establish safety zones around all power equipment.
16. Use audio-visual media to reinforce the safety message continuously.
17. Predetermine a plan of action in the event of envisioned emergencies.

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[1] Compiled from Kigin (1987), Hughes (1988), Matt & Murwin (1987), Vos & Pell (1988), *Industrial technology safety guide* (TX), et al.

18. Do not permit any students to leave the laboratory to perform activities outside the department without appropriate supervision.
19. Confine instructional and maintenance activities to those that can be performed in the laboratory.
20. Prepare and use accident forms for your laboratory if the school system does not have a standard form.
21. Administer safety tests to students upon completion of the demonstration of a specific machine or tool. Set a critical score above which students must achieve in order to utilize a specific item of equipment. Many instructors demand a "perfect score" prior to letting students use such equipment.
22. Personally set a proper example for students to follow by using guards and safety devices at all times and perform operations as you would want them performed by students.
23. Have students secure permission to use any item of equipment. This permits you to check to see that all guards and safety devices are properly adjusted.
24. Be familiar with the work habits of students and with those who possess physical limitations which may necessitate restrictions on their use of equipment. Limit students to the use of machines which are within their capabilities and commensurate with whatever physical abnormalities they possess.
25. Prepare for substitute instructors. If a certified industrial technology/technology education instructor is not available, prepare written or reading assignments in advance and preferably have the substitute teacher cover the class in a room other than the industrial technology/technology education laboratory. Do not permit a substitute teacher to conduct laboratory activities unless he/she is a certified industrial technology/technology teacher.
26. Permit only students who have participated in your laboratory program or who are participating to use the laboratory and equipment therein. No exceptions should be made to this practice. Do not take the word of a student that he/she has had previous instruction on the tool or has had experience in their use.
27. Keep an accurate instructional log as to those materials, machines and tools and operations for which instruction has been given, who attended, and who passed the tests.
28. Allow no student to bring in equipment for use in the laboratory which has not been purchased with the approval of the board of education/administration.
29. Do not be absent from your laboratory when students are working, even during unscheduled classes or periods. Have a clear understanding with your principal and/or supervisor that you are not to be called from the laboratory during a class session. Only under extreme necessity should an instructor absent herself/himself from the laboratory. When this occurs, bring in another person the school has authorized to watch the class, have students stop laboratory work, lock the main electrical power off and provide a reading assignment to students during your absence.
30. Know and follow all local procedures for the reporting of injuries. Typically, this includes reporting all injuries to your building administrator in writing with all details, including a full description of the accident, time, place, names

of injured persons and names of any witnesses. Protect yourself. All information and notification of an accident should originate from you.

31. Have all injuries, regardless of severity, examined by the school nurse.

5. Safety Instruction

ITE/TE instructors must recognize their responsibilities for the safety of their students. Because students are usually minors and because in all cases, they must be presumed to have incomplete mastery of the skill, knowledge and attitudes associated with the subject being pursued. Therefore, their instructors must provide for the careful development of those competencies necessary to operate safely in the laboratory, shop, or on the training site. This means that instructors must provide safety instruction. Furthermore, this **instruction must be systematic (thorough coverage), performance-based (provide clear evidence of accomplishment), reinforced periodically (involve repetition to counter forgetting) and it certainly must be documented (recorded on paper for others to review). Additionally, instructors must be certain to integrate their safety discipline policy throughout the instruction.**

Content and Organization

The safety instruction program employed by instructors should be based on an analysis of known safety hazards, activity requirements, standard precautions and the like. To identify the content that must form the core of a safety program, instructors must access a large number of safety standards specific to their subject area. Careful selection is necessary to achieve student mastery of three vital objectives:

- To recognize existing and potential hazards
- To understand appropriate defense/avoidance and/or prevention strategies
- To be able to act in time

In all cases, instructors are faced with the decision as to what content to build into the safety instruction. Another important point is to identify which safety instruction should precede all other work and which will be infused throughout the day-to-day instructional activity. It is recommended that instructors approach these decisions by identifying the prerequisite knowledges, skills and attitudes that are necessary to the safe functioning of students during their early learning activities. These need to be mastered before any laboratory experience begins.

Following this, the safety knowledge, attitudes and skills that are needed for subsequent activities must be built into the regular day-to-day instruction. In this way, students are not presented with an artificial dichotomy between "work" and "safety."

The safety program's instructional content needs to be carefully documented for purposes of effective organization as well as for the record. Both protect the instructor in the event of liability claims. Because it should be readily identifiable as a freestanding component of any course, the safety program needs to be developed with its own goals and objectives, its units of instruction and its own lesson plans. Instructors are advised to infuse as much safety instruction as possible into their "regular" instruction, to insure thorough treatment, it is recommended that they:

- Identify the safety content (knowledge needed, desirable attitudes, required skills) necessary to operate safely in the area being taught.
- Write the goals and objectives for the safety program.

- Organize the safety content into units of instruction.
- Detail each unit of instruction by identifying lessons to be taught in each unit.

Suggested Instructional Techniques: General

Safety instruction is more effective when a variety of approaches are employed and when it is tailored to the objectives being addressed. A comprehensive safety program provides for performance and attitudes in addition to knowledge. Therefore, the methods used must be selected appropriately. Furthermore, instructors are invariably faced with the task of not only teaching the necessary content once, but also of:

- Providing remedial safety instruction when students are not able to demonstrate the desired behavior after initial instruction.
- Providing back-up instruction to those students who were not in attendance during the original instruction.
- Providing reinforcement instruction to bring students back up to a level of performance previously attained but now forgotten.

A compilation[1] of instructional techniques from a variety of sources reveals the following suggestions:

1. Reinforce safety consciousness, and motivate students, by setting an example. Always do things the safe way while pointing out potential hazards.
2. Teach accident prevention with a positive approach—stressing the right way to perform an operation.
3. Present periodic laboratory demonstrations emphasizing the safe use of personal protective devices, potentially hazardous materials, machines and hand tools. Document instructions and attendance. Present safety instruction with the following objectives in mind:
    a. Develop in students a sense of responsibility for their own safety and that of others.
    b. Emphasize the relationship of hair protection and clothing to safety.
    c. Help students understand that the safe way of doing things is effective.
    d. Help students recognize situations involving potential hazards.
    e. Help students learn safe practices to use in their own day-to-day activities.
4. Provide instruction on what to do in case of an accident or emergency.
5. Use information sheets dealing with the general safety rules of the Industrial technology/technology education laboratory. Provide each student with the general safety rules of the laboratory.
6. Provide instruction in the basic maintenance of tools, machines and equipment.
7. Provide instruction in the safe methods of lifting and/or moving heavy equipment or other loads.
8. Use a bulletin board for safety bulletins, safety poster and safety rules and regulations. Change eye-catching features regularly. The *Technology Accident Prevention Education* series of comic books and posters is one effective way of motivating students. They are available from DIR Communications, Inc., 6198 Butler Pike, Suite 135, Blue Bell, PA 19422.

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[1] Compiled from Hughes (1988), et al.

9. Require all beginning students to make a careful study of potential hazards in the laboratory during the first few days of the course.
10. Utilize a student safety committee to strengthen the safety program. Foster student leadership through a student personnel system for accident prevention.
11. Use a bell, whistle, or some other type of alarm to command the attention of every student in the laboratory during emergency situations.
12. Periodically test students on the safety information with which they were provided. Check out each student on the procedures, tools and/or materials that he or she is about to use. Review the safety rules from time to time with each student—especially after a vacation or prolonged absence of the student. Be sure to document the reoccurrence of this instruction and testing.
13. Make students aware of the potential dangers of cleaning agents, cutting fluids, solvents, thinners, lubricants, and other hazardous materials.
14. Remind students periodically of the importance of keeping work areas clean and free of hazardous objects.
15. Maintain proper discipline! Student behavior will depend on the rules established for the laboratory. If students are kept busy and supervised, discipline will not be a major problem.
16. Periodically use discussion time to emphasize the importance of student attitude in accident prevention.
17. Send letters to parents when a student has exhibited a great degree of interest in safety or when he/she has successfully applied safety practices.
18. Prepare, and secure approval of, a written safety education program for the ITE/TE program and each course.
19. Provide work station "prompts," labels and signs to alert students to appropriate procedures, guards and personal protective equipment.

Suggested Procedures to Ensure Special Needs Student Safety

As a people, we believe in the right of individuals to a free and appropriate public education. Since every individual has special needs, educators need to tailor the education process to these needs. This is particularly important in the arena of practical arts safety. There, student learning and well-being depends upon the teacher's approach to the safety of the learning environment. This section has attempted to consolidate available safety recommendations and considerations for the special needs student in practical arts courses. Because of the need for specific assurance, instructors are additionally advised to consult special needs experts, particularly those versed in the specific disability involved, safety consultants, medical practitioners where appropriate and in all cases, the child-study team responsible for each special needs student's individualized educational plan (IEP).

Individualized Educational Plan Development

An individualized educational plan (IEP) must be provided for each classified special needs student. The program specifies those educational and related services which are to be provided for the student methods of assessing progress and the like. In developing an IEP, the educational agency and the student, along with parents or guardians, explore together the student's needs, the ways these needs may be met and which educational needs have the highest priority. Since instructional strategies are part of this process, when child-study teams consider technology education placement for a student, it is vital to his/her safety that the appropriate industrial technology/technology education instructor be involved in both placement and strategy development discussions. Certainly the student's safety and health should be considered within IEP development.

Suggested teaching techniques for special needs students

Effective teaching obviously serves special needs students as well as others not so classified. However, the implementation of certain practices maximizes the safety of vocational special needs students. Certainly these practices are desirable not only for how they help special needs students operate safely, but also for how they help other students do so. A sample[1] of these practices and precautions includes:

1. Assignment of students to specific shop/laboratory areas.
2. On-going observation of student work skills.
3. Enhancing teacher-student communication by using devices that improve reception and/or sending of information.
4. Individualization of instruction to meet specific special needs characteristics as suggested by appropriate consultants and by the IEP.
5. Minimizing access problems and barriers.
6. Medical records should be checked to determine if any special students are subject to seizures, fainting spells, etc. If students are enrolled who have one of these conditions, that individual should be given additional monitoring while using all equipment.
7. Isolation of a special needs student when rules of the laboratory are violated has been found to be one of the most effective methods of discipline. Keeping the student separated from the rest of the group should last no longer than absolutely necessary.
8. Some special needs students may have a tendency to wander about the laboratory area. They must understand that they have an area to which they are assigned and must stay there.
9. Testing of the special needs student's abilities should be done by continual observation by the teacher and demonstration by the student. Evaluation should use a variety of oral, written, and performance techniques, and not be limited to just tests requiring reading, writing and comprehension.
10. The teacher should design jigs and fixtures for work holding, safety and positioning to promote a higher level of student success while using tools and machines.
11. Plan to make your facility free from access barriers to sinks, tool cabinets, doorways, machines, workbenches, shelves, desks, etc.
12. Accept the student as he or she comes to you. Keep in mind that the student's success depends not only upon his or her own characteristics and abilities, but also upon the teacher's attitude and the quality of the learning environment.
13. Employ the aid of the special education resource people on your school staff. These people are specialists who can provide you with valuable information in dealing with the problems of the special needs students enrolled in your program.

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[1] Compiled from Hughes (1988), Dyrenfurth & Linhardt (1981) et al.

14. Provide teacher aides and VRE's, who help in the laboratory, with the same safety instruction as the students.
15. All students, including special needs students, respond favorably to frequent verbal praise and reinforcement. A "hands-on" environment provides positive feelings of success and also offers reinforcement through the finished product.
16. Encourage heterogeneous grouping with the classroom. Placing the special student within a small group of students with various abilities will provide him with models for behavior in a laboratory or other industrial type facility.

Civil rights mandate

The Rehabilitation Act of 1973, Section 504, was initially enacted into law to protect the civil rights of all handicapped Americans. The implementation regulations and enforcement provision did not become law until June 1977. Now, however, it provides greater opportunities for physically or mentally handicapped individuals. (Hughes, 1988).

General provision against discrimination

Any program or activity which receives federal financial assistance (1) may not exclude qualified handicapped persons from aids, benefits or services; (2) must provide equal opportunity to participate or benefit; (3) must provide services as effective as those provided to the nonhandicapped and (4) may not provide different or separate services except when necessary to provide equally effective benefits.

Services need not be identical to those provided to the nonhandicapped, but must be the equivalent of them and must afford an equal opportunity to achieve results in the most integrated setting appropriate to the person's "needs."

Teachers must make a special effort to insure the safety of disadvantaged and/or handicapped students.

Mainstreaming is the result generally associated with Section 504. It puts students in a "least restrictive environment," usually a regular classroom or lab situation. When one or two special needs students are mainstreamed into a regular class, special safety considerations and/or precautions must be taken by the teacher. Such situations will have to be adapted to the individual needs of the student and the program (Hughes, 1988).

Summary of implications for ITE/TE

The responsibility for safe working conditions in a school laboratory is the prime concern of the teacher and all students who work in the facility. With this in mind, the instructor of Industrial technology/technology education subjects should make a special effort to teach safety to the disadvantaged and handicapped students enrolled in his or her program. Many special students such as these will need added instruction in safety with emphasis on personal responsibility to themselves and others with whom they work. Initially, instruction should be given in a classroom setting for short periods using an abundance of visual aids to explain proper safety procedures. Small group demonstrations can also be very effective while using actual machines and tools. Individual instruction should follow the small group demonstrations before the students actually use the laboratory equipment. In addition, safety reviews should be repeated at intervals to help reinforce safety procedures.

Figure IV-3

Special Needs Resources

1. Missouri LINC, 401 E. Stewart Road, Rm. 200, University of Missouri-Columbia, Missouri 65211. Toll Free Hotline: 800-392-0533 for answers to questions related to industrial technology/technology education, vocational education and special needs students
2. Vocational Instructional Materials for Special Needs Groups Human Resources Management, Inc. 1101 30th Street, N.W. Suite 301, Washington, D.C. 2007
3. The National Center for Education and Employment, 1960 Kenney Road, Ohio State University Columbus, Ohio 43210. Toll free: 800-848-4815.
4. Midwest Regional Resource Center, Drake University, Des Moines, Iowa 50311 (515) 271-3936
5. Instructional Development for Special Needs Learners, Department of Vocational and Technical Education, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801.
6. Vocational Education Inservice Training Department of Special Education, University of Kansas Medical Center, Children's Rehabilitation Unit/University Affiliated Facility, Kansas City, Kansas 66103.
7. Wisconsin Vocational Studies Center, University of Wisconsin-Madison, 964 Educational Sciences Building, Madison, Wisconsin 53706, (608) 263-3696
8. The Career Education Center, Florida State University, Florida State Department of Education, Division of Vocational Education, Tallahassee, Florida 32306
9. LINC Resources, Inc., 1875 Morse Road, Suite 225, Columbus, Ohio 43229
10. The President's Committee on Employment of the Handicapped, Washington, D.C. 20210

6. Safety Evaluation

Evaluation in the context of safety includes both the assessment of student capability (testing) and the assessment of the overall programs, including facility, equipment, curriculum and policies; incorporation of provisions for safety. Both aspects of evaluation are important and useful ideas will be presented in the following sections.

Teaching safety is a very complex and difficult task. It involves the psychomotor, cognitive and affective domains of student behavior in situations where it is sometimes difficult to measure/monitor progress. Also, because each student is an individual, evaluations should be designed to test students in a variety of ways. Regardless of design, safety evaluations must reflect the material and objectives presented in the instruction and then the results should be carefully recorded.

Student Safety Testing

Essentially there are three reasons to test students for mastery of safety knowledge, attitude, and skill:

- To document that they have mastered sufficient skill and knowledge to permit them to **begin** laboratory work and then gradually build their repertoire
- To identify whether they have mastered the necessary skills and knowledge and thereby that they are ready to work with a particular machine or process
- To ascertain that students have retained sufficient amounts of previously demonstrated skills, knowledge and attitudes in order to permit them to **continue** with laboratory work

Obviously a wide variety of techniques can be used to test safety knowledges, attitudes and skills. However, because of legal and moral issues, it is vitally important that they be valid and reliable—otherwise instructors will find they are of no value to them or their students. Some of the more commonly used tests types are:

- Pencil and paper—a written exam which may be administered at varying intervals after instruction. This could be an examination on general safety rules or on specific safety rules for machines or equipment. Avoid true-false tests.
- Observation of performance—using a checklist of safety rules/procedures to note whether, or to what extent, students use specific machines and/or equipment according to the manner that was demonstrated and taught.
- Critical incident technique—An observation technique that has instructors identifying attitudes and/or practices that students should demonstrate. Instructors then specify a series of descriptions (critical incidents) that exemplify the varying degrees to which a student can demonstrate the desired behavior. Rating students then involves observations for a period of time and then recording which of the "critical incidents" were noted, thereby indicating the extent to which the student has demonstrated the desired behavior. Figure IV-4 provides a sample of a critical incident rating scale.

Time of Testing

Initial testing of students, the first of the listed purposes, should be completed **before** students enter the shop/laboratory and before using any machines, equipment and material. Then, gradually, additional instruction and testing will establish further skills throughout the course. Subsequently, testing should be used to maintain the safety knowledge of the students. Such examinations could be quarterly or by the semester.

Figure IV-4

Sample Critical Incident Technique Safety Rating Format

Instructions: Rate the student's concern for safety by circling the behavior descriptor *in each row* that best describes the student's behavior during the time you observed him/her.

	Degrees of Concern for Safety *Low*			*High*
Safety Area Being Rated	**Poor Safety Attitude**		**Positive Safety Attitude**	
Housekeeping	Leaves tools and equipment in work area, does not clean work area before or after working.	Replaces tools. Begins and finishes work without cleaning up his/her work area.	Cleans up area after job is completed, but is less concerned with problems outside his/her work area.	Observes various safety hazards and works to correct even if outside of his/her direct work area.
Personal Protective Equipment	Has to be reminded to wear safety glasses, aprons, proper shoes, etc., several times during the class.	Occasionally fails to use required protective equipment for the job being performed.	Always uses personal protective equipment, usually attempts to clean equipment before or after use.	Uses protective equipment for each job performed. Performs daily maintenance on equipment. Cleans equipment before **and** after use.
Machines and Equipment	Attempts to adjust machine while it is running. Does not use proper guards and procedures.	Occasionally fails to following operating instructions for machines. Does not think through operations.	Insures guards are in place while operating equipment. Reads and follows instructions.	Follow safety rules and regulations. Cares for the safety of others while in his/her work area. Informs instructor of safety hazards.
. . . .				

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Safety Test Criterion Levels

All examinations should be criterion-based in order to insure the safety knowledge of students. This means that instructors are advised to establish a minimum passing level (typically 100%) that students must attain before being allowed to work in the laboratory and/or use a specific machine. Instructors should note that in contrast to criterion-based grading, normative grading, which is based on comparisons of students, one to another, would not ensure mastery of safety content if, for example, an instructor were faced with a less than able class. Special needs students will need individual consideration and occasionally alternative tests but safety standards should never by compromised.

Reliability and Validity of Examinations

In order to develop and maintain valid and reliable examinations for evaluating the safety knowledge of students, instructors should carefully analyze the evaluation instruments. To aid in this, instructors can use the following approaches:

- Advisory Council—Provide advisory council members with copies of examinations and other evaluation forms. Ask members to critique the examinations and recommend revisions.
- Other Teachers—Exchange examinations with other teachers who are teaching the same courses as you. Review the techniques they use and if appropriate, implement them into your program.
- Item Analysis—Perform an item analysis on examinations in order to remove and/or revise questions which are not pertinent to the objective of the test.

Qualifying on Equipment/Machines/Tools

Instructors have found it wise to follow a systematic procedure for qualifying student to use a machine, tool, or complex process. The highlights of a recommended procedure are:

1. Initial Orientation—Orientation involves the familiarization of students with a piece of equipment and its uses. Parts are identified and adjustments explained to the students as are the safety features. Safety should be an integral part of the orientation as well as through the remainder of the instruction.
2. Demonstration—The instructors show proper use of the equipment/operation by proceeding through the following steps: (a) preparation, (b) operation, (c) shut down.

   When demonstrating operations and/or skills, the following suggestions are appropriate to maximize safety instruction (*Industrial Arts Safety, Idaho*, p. 28):

   a. Be sure that all students can observe the demonstration.
   b. Emphasize the positive aspects of safety involved in the operation, while at the same time pointing out possible dangers involved to students.
   c. Be sure to provide students an opportunity to ask questions concerning "what" is to be done and how it is to be done.
   d. Review the material presented, going through the steps one by one so as to clarify any doubts students may have as to how the operation is performed.
   e. Review the safety suggestions or practices pertaining to the skill and/or operation.

3. Safety Check—All students must pass a safety exam before being allowed to use any power machinery. The exam is used to measure their knowledge regarding the machine and its safe operation. If a student fails the exam, the missed questions should be reviewed with the teacher and perhaps reinforced through review of the demonstration steps. If the wording of exam questions seems confusing, then it may be necessary to have an individual oral exam, which should be documented and signed.
4. Student Performance—The student is allowed to use the machine for the first time under the supervision of the instructor. The teacher guides the student through the operation and corrects any unsafe acts until he/she is satisfied with the students' safe performance. After a student successfully performs, he/she will be qualified to operate and use the particular machine.
5. Qualification Completed—After a student has qualified on a machine or piece of equipment. This status should be recorded and made a part of his/her lab file. Retest results should also be recorded.

7. Record Keeping

It is absolutely essential for instructors to keep safety-related records. One main objective for this is to call attention to accident prone areas/processes so that steps may be taken to correct an unsafe condition. Records may also be used to protect an employee (instructor) and/or the employer (administrator and board) if either is required to provide evidence of instruction or use of proper safety procedures. Additionally, such records assist instructors in tracking student progress and subsequently in tailoring instruction to meet individual needs. Among the recommended record keeping procedures are:

> **It is absolutely essential for instructors to keep safety-related records.**

1. Require each student to sign information sheets dealing with laboratory safety rules and regulations to indicate that he/she has read and understood the regulation. A copy of the information sheets should be kept on file and students should keep the original along with relevant instructional material.
2. Require students to demonstrate appropriate levels of proficiency on safety tests before using equipment. Subsequently, students should have to sign their names on each test and thereby indicate that they have received instructions and passed the safety examination.
3. Prepare a classroom chart to indicate safety instruction given, date of instruction, student attendance and safety test performance.
4. Prepare and file an accident report form for each injury requiring treatment.
5. Notations citing date, time and circumstances should be made of chronic disruptive behavior and violations of safety procedures. These notations should be placed in each student's cumulative folder, reviewed regularly with the student and, where necessary, referred to administration for appropriate action (*Texas Industrial Technology Curriculum Guide*, p. 291).
6. Keep records for a period of time as advised by school counsel. Retain all safety information sheets and tests in student files in instructor's office. Keep

records of all instruction, student attendance, student test performance, actual safety tests, maintenance of records, memos and letters and related safety documentation.

7. Among the more important records to maintain are the following. Each is explained in subsequent sections.
   - Accident reports
   - Hazardous condition report
   - Parental safety authorization
   - Safety instruction acknowledgement

Hazardous Condition Report

To keep safety format in student's minds, safety reports are suggested as a method for reporting a hazard and directing action to see that the hazard is corrected or removed. If a hazard exists, the machine or operation should be "blue tagged" and shut down until corrected. **NOTE: This form can be used to report a student who is a hazard as well as a hazardous condition in the laboratory.**

Figure IV-5

Hazardous Conditions Report

Reporting Teacher: ______________ Date: ____________________

Building Administrator: ______________ School: ____________________

Description and Location of Health or Safety Hazard:

____

____

Recommended Action:

____

____

Estimated Cost: $ ____

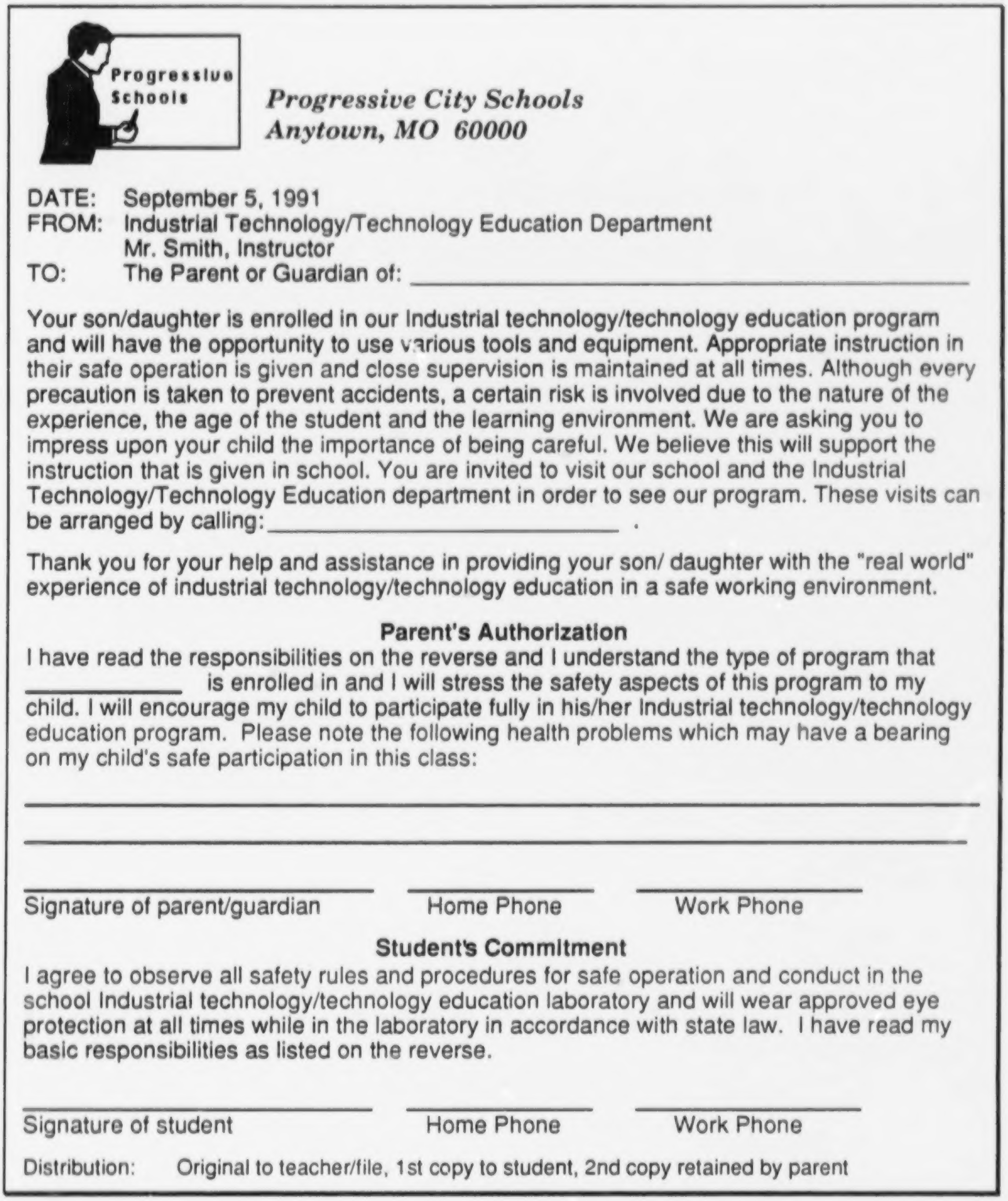
Degree of urgency: ____

Distribution:

Original	Building Administrator
1st Copy	Department Chairperson
2nd Copy	Teacher Reporting Hazard
3rd Copy	District Safety Officer

Figure IV-6

Parental Safety Authorization[1]



Progressive Schools

Progressive City Schools
Anytown, MO 60000

DATE: September 5, 1991
FROM: Industrial Technology/Technology Education Department
Mr. Smith, Instructor
TO: The Parent or Guardian of: ______________________________

Your son/daughter is enrolled in our Industrial technology/technology education program and will have the opportunity to use various tools and equipment. Appropriate instruction in their safe operation is given and close supervision is maintained at all times. Although every precaution is taken to prevent accidents, a certain risk is involved due to the nature of the experience, the age of the student and the learning environment. We are asking you to impress upon your child the importance of being careful. We believe this will support the instruction that is given in school. You are invited to visit our school and the Industrial Technology/Technology Education department in order to see our program. These visits can be arranged by calling: ____________________ .

Thank you for your help and assistance in providing your son/ daughter with the "real world" experience of industrial technology/technology education in a safe working environment.

Parent's Authorization

I have read the responsibilities on the reverse and I understand the type of program that ________ is enrolled in and I will stress the safety aspects of this program to my child. I will encourage my child to participate fully in his/her Industrial technology/technology education program. Please note the following health problems which may have a bearing on my child's safe participation in this class:

____

____

Signature of parent/guardian	Home Phone	Work Phone

Student's Commitment

I agree to observe all safety rules and procedures for safe operation and conduct in the school Industrial technology/technology education laboratory and will wear approved eye protection at all times while in the laboratory in accordance with state law. I have read my basic responsibilities as listed on the reverse.

Signature of student	Home Phone	Work Phone

Distribution: Original to teacher/file, 1st copy to student, 2nd copy retained by parent

---

[1] Adapted from Hughes (1988).

Basic ITE/TE Safety Responsibilities

Student responsibilities

1. Abide by the safety rules and observe safety practices at all times.
2. Assist in evaluating and updating safety procedures.
3. Recognize personal limitations.
4. Assist in maintaining equipment in safe working order.
5. Keep work areas clean.
6. Use proper dress, guards and protective equipment.
7. Follow instructions and indicate when they are unclear.
8. Report unsafe conditions to the instructor or supervisor.
9. Be considerate of other students in order to prevent their injury through unsafe actions.
10. Give proper attention to safety instruction.
11. Be informed and prepared to handle an accident, emergency, or disaster.
12. Develop sense of responsibility for personal safety.
13. Acknowledge safety instruction received.

Parent responsibilities

1. Support and cooperate with instructors in encouraging students to respect and comply with the safety laws and regulations.
2. Participate in expanding safety educational experiences and cooperate in carrying out subsequent action programs.
3. Review industrial technology education's safety program and indicate recommended additions and/or perceived problems.
4. Indicate to industrial technology/technology education faculty your recognition of risks inherent in such activity.

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Safety Instruction Acknowledgement

A form that can be used to demonstrate in writing that a student did receive safety instructions is presented in Figure IV-7. Note that each machine in the laboratory can be listed along with the date the student passed performance evaluation. The purpose of this form is to document that each machine was demonstrated to every student, that each student operated the machine safely, and that the student reinforced his/her responsibility by signing the sheet.

Figure IV-7

Acknowledgement of Safety Instruction

ACKNOWLEDGEMENT OF SAFETY INSTRUCTION

Course name ____________________ Student name ____________________

Semester __________ Period ____ School year ____________________

I have received SAFETY INSTRUCTION on the equipment listed below and I have passed the related SAFETY EXAM. I fully understand the importance of the safety instruction and the proper operating procedures and that the violation of any one of them may be dangerous to myself and others.

My teacher has demonstrated to me the proper methods and safety precautions regarding the equipment listed below. I have qualified as an operator by demonstrating my ability to safely work with the equipment but only under the supervision of my teacher.

I am confident that I can operate the equipment safely and that I will report any unusual conditions or defective parts to my teacher immediately. If I am in doubt about any adjustment or operation of any equipment I will have the teacher check it out before proceeding with any work.

DIRECTIONS: List mastered items, the date and your signature after you have received safety instruction, passed your safety exam and demonstrated your ability to use it.

Teacher Signature	Name of Machine	Date	Student Signature

Figure IV-8

Student Safety Performance Record[1]

School ______________________ Teacher __________________________

Program ______________________ Period __________ Year __________

__________________ has observed safe operating procedures & has passed the
Student's Name
required written and performance safety exams, and therefore is permitted to operate the items dated according to accepted safety regulations.

	Machine/Process Names			
Student Name	**Table Saw**	**Robotic Arm**	**Laser**	
Fred	D: ______ T: ______ P: ______	D: ______ T: ______ P: ______	D: ______ T: ______ P: ______	D: ______ T: ______ P: ______
Susan	D: ______ T: ______ P: ______	D: ______ T: ______ P: ______	D: ______ T: ______ P: ______	D: ______ T: ______ P: ______
	D: ______ T: ______ P: ______	D: ______ T: ______ P: ______	D: ______ T: ______ P: ______	D: ______ T: ______ P: ______
	D: ______ T: ______ P: ______	D: ______ T: ______ P: ______	D: ______ T: ______ P: ______	D: ______ T: ______ P: ______
	D: ______ T: ______ P: ______	D: ______ T: ______ P: ______	D: ______ T: ______ P: ______	D: ______ T: ______ P: ______
	D: ______ T: ______ P: ______	D: ______ T: ______ P: ______	D: ______ T: ______ P: ______	D: ______ T: ______ P: ______

The teacher will keep this record in the student's file.

D = Date student observed safety demonstration
T = Date student passed written safety test
P = Date student passed performance safety test

---

[1] Adapted from Deluca & Haynie (1989).

Accident Reports

Accident reports are an essential part of a good safety program. They help to inform, educate and remind people of what to look for in regard to accident prevention. They also provide an important record of safety infractions and safety precautions. Additional details and benefits are available in Langlois & Trott (1987). The following procedure is one that could be employed:

1. Fill out the accident report form within 24 hours of the incident. This guards against details that may become vague after a few hours have passed and that may thereby affect the report's accuracy. Have the student describe what happened in writing or on tape.
2. Prepare your report in duplicate. One should be hand-delivered to the principal (or supervisor) and another should be kept in your personal files.
3. Include information on the basis of how, where, what, who, when and why the accident happened in reconstructing the sequence of events.
4. The U.S. Department of Labor has recommended that the following principles should be observed in preparing reports:
    a. Use common sense—Stick to the facts, weigh their value, reach justified conclusions.
    b. Investigate each clue—Apparently reasonable conclusions will often be changed by exploring factors which initially may not appear to be important.
    c. Check for unsafe conditions and facts—Both are present in the great majority of accidents.
    d. Make recommendations—No investigation is complete unless corrective action is suggested and carried out.
    e. Investigate all accidents—Chance is often the sole difference between a trivial accident and a serious one. Results cannot be predicted.

Figure IV-9 presents a Standard Student Accident Report Form developed by the National Safety Council. This form is straight-forward, yet it obtains a large amount of data to document an accident effectively. It is also a very efficient method that yields data for the summary report that should be developed at least annually. Such a summary organizes data so that corrective actions can be taken to prevent recurrence of accidents.

Additional information about student accident reporting is available from the National Safety Council. They have made available, to all school districts that enroll 300 students or more, the *Student Accident Reporting Guidebook.* This guide can be obtained by writing to the National Safety Council at 425 N. Michigan Avenue, Chicago, IL 60611.

Reporting Summary

An effective and efficient reporting system is one which provides pertinent information about all students in all program areas and by which all accidents can be recorded and analyzed with a minimum of time and effort. Space should be provided for details and adequate instructions for completing the report form. Quite often, special studies for the technology area of school systems, or a statewide program, will justify a special reporting system as a supplement to individual reports. Figure IV-10 provides an example of a useful summary form.

Figure IV-9

Student Accident Report Form[1]

__ School Jurisdictional
__ Non-School Jurisdictional

__ Recordable
__ Reportable Only

School District: ______________________________

City, State: ______________________________

1. Name: ______________ 2. Address: ______________

3. School: ______________ 4. Sex: ________ 5. Age: ________ 6. Grade: ____

7. Time Accident Occurred: __________ Day of Week: _________ Time: _______ a.m. p.m.

8. Nature of Injury: ______________________________

9. Part of Body Injured: ______________________________

10. Degree of Injury: Death: ___ Permanent: ___ Temporary: ___ Non-Disabling (no lost time): ___

11. Days Lost: From School: _____ Activities Other Than School: _____ Total: _____

12. Cause of Injury: ______________________________
____

13. Accident Jurisdiction
__ School __ Grounds __ Building __ To and From: _____
__ Non-School __ Home __ Other: __________ __ Activities not on School Property

14. Location of Accident (Be specific): __________
____

15. Activity of Person: ______________
____

16. Status of Activity: ______________
____

17. Supervision (if yes give name & title): ________
____

18. Agency Involved: ______________

19. Unsafe Act: ______________

20. Unsafe Mechanical/Physical Condition: ______
____

21. Unsafe Personal Factor: ______________
____

22. Corrective Action Taken or Recommended: ______________________________
____

23. Property Damage: School $_______ Non-School $_______ Total $_________

24. Attach instructor description (give a word picture of the accident, explaining who, what, when, why and how)

25. Attach student description of accident (as soon as possible)

26. Attach witness(es) description of accident (as soon as possible)

27. Date of Report: ______________________

28. Report Prepared by (signature & title):
____

27. Principal's Signature:
____

---

[1] National Safety Council recommendations.

Figure IV-10

School Accident Summary Form

Period From/To:	School:
Compiler:	Subject:

Case Number	Name of Injured Person	Date of Injury	Location of Accident	Nature of Injury	Part of Body	Source of Injury	Tools & Equipment Involved	Time Lost	Hazardous Condition	Human Error	Instructor or Supervisor
91-1	William Smith	91: 1/9	ITE M&P laboratory	Laceration	Left Hand	Saw blade	Circular table saw	1/2 day	Unguarded saw blade and slippery floor surface	Failure to secure permission to operate saw and failure to clean floor area around saw	Mr. George

8. Emergencies[1]

Preparation is the best way to cope with emergencies. It is recommended that instructors post emergency procedures and contact mechanisms, such as shown in Figure IV-11, prominently. In addition, students should be taught what these procedures mean, when to use them, and how to get additional help.

First Aid & CPR

It is not the intent to teach first aid procedures or CPR techniques in this section. Rather, the attempt is to put emphasis on the reasons that one should learn basic first aid and CPR techniques.

Student safety is always on industrial technology/technology education teachers' minds. Injuries will occur even though instructors practice and teach safe work habits. Teachers should be aware of the school district policy on the treatment of injuries. Even though the school nurse may be the individual who treats injuries, there are a few simple things that can help to make a difference in the outcome of an injury situation.

Knowing simple first aid procedures can and may make the difference in lessening the pain and discomfort. Being able to identify whether or not a student is not feeling well and why could help to eliminate accidents both in the school laboratory, on field trips and in class functions. Instructors are responsible for the safety and well being of students while they are involved with school work.

Students with a history of medical problems and who are IEP-placed in industrial technology programs should be made known to the instructor. This information is confidential and should not be discussed with students or other teachers (unless there is a professional reason). It is important to know these problems and related symptoms should problems begin to arise. Quick and appropriate treatment is a must in certain situations. This can be jeopardized when medical problems and/or medications are not known by both the school nurse and the teacher. Furthermore, some medications have side effects that can cause the student to be hazardous to themselves and others by having to take the medicine. Without knowledge of this, a student could cause injury to them and others that could be avoided.

Injuries to students should be noted in an accident/injury report for future reference should it be necessary. Students who receive trauma related injuries, falls, head, back, or neck injuries, should not be moved until **qualified EMS personnel** can assess the student. Moving a student that has a trauma injury can and may further the injury unnecessarily. Injuries of this nature are severe enough without complicating the injury further. Complications can include paralysis, nerve damage, loss of consciousness and pain.

> **Students who receive trauma related injuries, falls, head, back, or neck injuries, should not be moved until qualified EMS personnel can assess the situation.**

---

[1] Developed by Mark Arnold.

Treatment of Injuries

Typically state and school policy, as well as good practice, call for ITE/TE instructors to avoid supplying or administering medication. In fact, teachers are well-advised to avoid any treatment (other than first aid) of a wound or injury. It is also recommended that each ITE/TE instructor have taken a certified first aid course. To provide for students' safety, be sure to instruct them to report all injuries—no matter how small—to the instructor and the school nurse!

1. Keep calm.
2. Send a designated student to the principal and/or school nurse.
3. Restore breathing.
4. Stop bleeding.
5. Prevent shock.
6. Notify school administration and the injured student's parents or guardian.
7. File accident report form.

The Missouri secondary science safety manual (1990) provides the following advice to teachers:

"A teacher should not diagnose, treat or offer mediation, but may offer the necessary first aid until medical help is obtained."

District Emergency Procedures (Fire, Tornado, Earthquake...)[1]

(Note: Insert a copy of your district's emergency procedures, such as evacuation procedures, hazardous materials spill policies and so forth behind this page.)

When arranging a laboratory facility, keep exit areas in mind. Placing fire hazards near exits could block a route that students need for escape. Such things as welders and finish areas fall in this category. Keeping exit areas clear and free of clutter at all times is necessary. Assess the current school evacuation plan for fire, tornado and earthquake procedures and see if there are areas where the technology laboratory/ classroom could have a problem with escape routes should they be necessary.

Seriousness in all drill situations is a must. Students generally fail to see why they are necessary, other than to disrupt class time. If it were the real thing, then student reaction is totally different. Discussing where students are to gather is also very important. Situations can arise where evacuation routes have to be altered—especially in laboratory situations. The normal escape route may be blocked or the class may become separated. Knowing what to do is important. Practice of these exercises and contingencies should be done. Note that drills or exercises can be conducted at other times other than during school-wide drills.

Assess items that hang in the laboratory. Cabinets that are attached to the wall are less likely to tumble over in an earthquake situation. However, items that hang from the ceiling are likely to fall in earthquake situations. A few extra screws and/or a strap can make laboratories safer at such times. If free-standing partitions and temporary walls exist in your laboratory, they can be made secure by putting furniture up against each side of the units. Similarly, free-standing bookshelves can be made more secure by arranging them in an L or by butting them back to back with another unit. Alternatively, one end could be secured to a wall.

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[1] MODESE's *Administrative guidelines for school safety* provide additional suggestions for emergency situations.

Figure IV-11

IMPORTANT SAFETY/EMERGENCY/PROBLEM TELEPHONE NUMBERS

(POST CONSPICUOUSLY)

Standard Emergency Number ______________________

Building Principal ______________________

School Health Service ______________________

District Safety Officer ______________________
(Name)

District/County Safety Specialist ______________________
(Name)

Police/Sheriff ______________________

Fire Department ______________________

Ambulance Source ______________________

Hospital ____________ ______________________
(Name)

Poison Control Center 1-800-366-8888; in St. Louis 314-772-5200

City/County Health Department ______________________

Animal Control (Pound) ______________________

Contact for Chemical Disposal ______________________

Local Emergency Planning Commission ______________________

Emergency Management Agency ______________________

National Response Center 1-800-424-8802
(Oil & Toxic Chemical Spills)

Instructions for Accessing Nearest Phone: ______________________
____

Nearest Fire Alarm: ______________________

9. Organization and Approval of the Overall Safety Program

Several points are essential to a carefully organized and properly endorsed safety program. Most importantly, such a program will exist both on paper and in practice. In other words, a safety program will not exist merely on paper as a compliance document, **but it will occur in the day-to-day practice of the program**. A complete safety program will include a wide variety of components:

1. A statement of the educational system's general policy for the safe operation of ITE/TE courses.
2. A statement of objectives for ITE's overall safety program.
3. A content outline of the safety information to be incorporated in each course.
4. An outline of the methods used to provide safety education to students.
5. A description of the methods and instruments to be used to assess student knowledge and skills as they relate to safety.
6. Separate and specific statements of practices and precautions required for safe operation within each individual course.
7. A plan for the periodic inspections and maintenance of facilities, materials, tools, machines, equipment and personal protective devices (as appropriate) used to provide instruction.
8. A staged (time-lined) plan for the eliminations of all known hazards and problems.
9. Specifications of the emergency procedures to be followed in the event of an accident/injury involving a student, teacher or other individual for each separate ITE/TE facility.
10. A description of the record keeping practices to be employed in documenting safety instruction, attendance and control of class movements and of accidents/injuries that occur.
11. A plan for the ongoing in-service training of instructors in safety-related content, skills and procedures.
12. The adoption of an overall school safety policy is strongly recommended. A sample of such a policy is presented in Figure IV-12.

Format/Organization

It is recommended that each system and/or program organize their safety programs in a loose-leaf format with tab dividers to reflect each major section as outlined above. Furthermore it would be advantageous to provide each instructor with copies of the general sections as well as of the sections that pertain specifically to his/her own service area (and courses). In addition, it will be important that one complete manual be available in each building.

Safety Approval Procedures

Ultimately, the most significant safety program approval that can exist is that from the Board of Education that governs the system/institution involved. Consequently, it is recommended that each board consider itself responsible to review and formally approve a carefully developed, systematic, system-wide safety program. Because boards have a reasonable right to expect that materials presented to them are appropriate and thorough in their content, it is recommended that instructors follow the approval sequence as shown:

1. Conduct a local instructor and supervisor workshop to orient staff to that which is needed, to assign development responsibility, and to establish time lines.
2. Hold meetings to consolidate the specifics of the safety program and to coordinate treatment of safety items in each course.
3. Request input and revision from the state industrial technology supervisor and from program advisory councils.
4. For larger systems, hold a system-wide meeting of faculty to coordinate safety programs across the board.
5. Prepare a brief outline of the steps used to develop the system's safety program and secure your principal's approval of the overall program. Then, together with a cover letter from the principal, route the complete program outline and cover letter through the superintendent to the president/chairperson of the Board of Education and request formal approval.

Figure IV-12

Model School Safety Policy

Accidents are undesirable, unplanned occurrences which can be prevented and they often result in bodily harm, loss of school time, property damage, possibly expensive legal action and even death. Thus, it shall be the policy of the ________________ School District to take every reasonable precaution for the safety of the students, employees, visitors, patrons. and all others having business with this school district. The Board of Education believes that safety education and accident prevention are important to everyone concerned with our schools, not only as a protective measure during school hours, but also as an instructional means of developing an appropriate mode of behavior to minimize accidents at all times.

It shall be the responsibility of the district's chief administrative officer to execute this policy in order to have a comprehensive program which will meet the needs of the School District.

The responsibility for developing the total safety program shall be delegated to a competent, professional staff person who will be directly responsible to the superintendent.* He/she shall be provided with staff, time, budget, authority and title commensurate with the task.

This staff person, acting in an advisory capacity to all heads of major units within the district, shall be responsible for the promotion and development of an aggressive accident prevention and safety education program for students and professional and nonprofessional personnel employed by the district.

The general areas of responsibilities include, but are not limited to, in-service training, development of accident prevention procedures, accident record keeping, plant inspection, driver education, vehicle safety programs, fire prevention, school site selection, emergency procedures and traffic safety problems related to employees, pupils and the community.

Approved by the National School Boards Association *Approved by the Association of School Business Officials, with the following modification to substitute for the word "superintendent": ". . . assistant superintendent in charge of business, or another administrator of comparable rank, other than the superintendent." For total safety program information, write to the School and College Department, National Safety Council, 444 North Michigan Avenue, Chicago Illinois 60611.

10. Facility Specifics

Facility characteristics interact extensively with instructional activities to affect the student's and teacher's overall safety. Many aspects are detailed in this guide's chapter III but specific details will need to be researched by architects, engineers and safety experts. This section of the safety chapter highlights nine factors affecting facility safety. They are: color, floors, noise, fire, ventilation, eye protection, sharps/infection, hazardous materials, and inspections.

Facility Color[1]

YELLOW—To designate caution and for marking physical hazards such as striking against, stumbling, falling, tripping, and "caught in between." Solid yellow, yellow and black stripes, yellow and black checkers should be used to attract attention to the area of concern.

RED—Basic color of fire related equipment such as fire protection equipment, alarm boxes, fire blanket boxes, fire buckets or pails, fire exit signs, fire extinguishers and their location, and fire hose location.

ORANGE—To designate dangerous parts of machines or energized equipment which may cut, crush, shock, or otherwise injure. Orange should emphasize such hazards when enclosure doors are open or when gear, belt, or other guards around moving equipment are open or removed.

GREEN—The basic color for designating "safety" and the location of first aid equipment other than fire fighting equipment.

BLUE—Used to designate caution, limited to warning against the starting, the use of, or the moving of equipment under repair.

BLACK—A combination of black and white should designate traffic and housekeeping markings. Solid white, solid black, single color striping, alternate stripes or black and white checkers should be used in accordance with local conditions.

Floors[1]

The following items should be considered when planning facility safety.

- Safety zones should be marked around machines to provide ample work space for the operator and to prevent interference with the operator.
- Nonskid material should be adhered to the floor where the operator works. Mats or slats are not recommended.
- Machines and equipment should be arranged so that materials are processed in an orderly and efficient manner that does not interfere with other workers.
- Aisles should be kept clear at all times. The recommended minimum width is 48 inches, with 36 inches considered an absolute minimum.
- Floors should be kept clear of all foreign materials which could cause falls. Immediate clean up of spills will help prevent accidents.
- Concrete floors should be sealed and not painted. Care should be taken to keep floors from becoming slick.

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[1] from *Industrial technology safety guide.*

Noise

Some facilities produce higher noise levels than others so specific figures cannot be cited for given machines with accuracy. The noise level, along with the time of exposure, must be kept to acceptable levels. Noise reduction can be controlled with personal ear plugs or muffs, acoustical treatment, or construction with sound absorbing materials. According to Smithkey (1991), ITE/TE instructors should implement a systematic noise reduction program that includes a hearing assessment for each student, an audiogram test, a laboratory sound level reading, and "instruction on noise, noise-induced hearing loss, and the proper use of hearing protection" (p. 15). The estimated noise levels produced by common sources are depicted in the top part of Figure IV-13 and permissible noise levels in the bottom part.

Figure IV-13

Recommended Noise Standards

Decibels	Activity
70	Normal speaking voice at 3 feet
75	Classroom teaching voice at 3 feet
80	Inside car (windows open—55 mph)
80-90	Grinder, lathe, arc welding
90-99	Saws, router, lawn mower
100-109	Wood jointer, pneumatic press
115	Planer, firecrackers
120-129	Pneumatic air hoist, internal combustion engine test
130	Jet engine and loud rock and roll concert

Permissible Noise Exposures[1]

Duration per day in hours	MODESE *Administrative Guidelines for School Safety*	Sound Level dBA slow response
8		90
6	85	92
4	90	95
3	97	
2	95	100
1.5	102	
1	100	105
.5	105	110
.25 or less	110	115

No exposure to continuous or intermittent noise in excess of 115 dBA!

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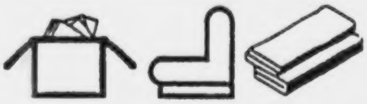
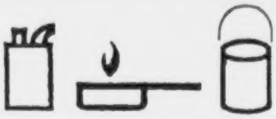
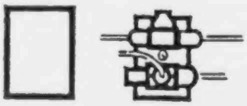
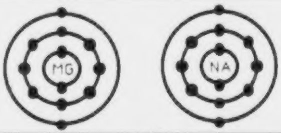
[1] From NIOSH guidelines and *Pennsylvania Industrial Arts/Technology Education Safety Guide*, p. 189.

Fire Safety[1]

1. Provide approved fire extinguishers in the laboratory area. Multipurpose dry chemical units are most effective for general use. Water back-up for extinguishers is often desirable. Multi-purpose dry chemical can damage delicate electrical equipment. CO_2 type extinguishers reduce that possibility. The general matches of extinguisher and fire types are shown in Figure IV-14.
2. Fire extinguishers should be located along normal paths of travel and must not be obstructed or obscured from view.
3. Store flammable liquids in approved (Underwriters Laboratories or Factory Mutual labeled) safety containers and cabinets.
4. Provide for the bulk storage of flammable materials in an area removed from the main school building.
5. Provide Underwriters Laboratories listed oily waste containers for oily and paint soaked rags. It is a good policy to place waste with high spontaneous combustion potential in water filled containers.
6. Fire blankets should be provided in each facility and instructors and students trained in their use.[2]

Figure IV-14

Fire and Extinguisher Matches

A	**Ordinary Combustibles** Fires in paper, cloth, wood, rubber, and many plastic require a water type extinguisher labeled A.	
B	**Flammable Liquids** Fires in oils, gasoline, some paints, lacquers, grease in a frying pan or in the oven, solvents and other flammable liquids require an extinguisher labeled B.	
C	**Electrical Equipment** Fires in wiring, fuse boxes, energized electrical equipment and other electrical sources require an extinguisher labeled C.	
D	**Metals** Combustible metals such as magnesium and sodium require special extinguishants labeled D.	

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[1] General fire safety information is available in MO DESE's *Administrative guidelines for school safety.*

[2] Details of use available from Lemmons, 1990, p. 11.

Ventilation

Ventilation helps promote effective instruction by increasing student alertness, laboratory cleanliness, and safety. The primary concern is climate control and air purity. Contaminants must be removed by the system and fresh air metered in. Details of proper ventilation go beyond the scope of this chapter but they are well documented in standard references. Some selected points specific to ITE/TE include:

Ventilation helps promote effective instruction by increasing student alertness, laboratory cleanliness, and safety.

1. Use local exhaust systems wherever quantities of particulates or contaminates are generated. Examples include:
    - Welding
    - Small engines (running)
    - Sanding
    - Darkrooms
    - Plastics processing
    - Finishing/painting
    - Clean-up areas
    - Chemical work
2. Arrange local exhaust systems to pull the contaminants away from the breathing area of the student working at that station.
3. Fume hoods should have a face velocity of 60-100 cubic feet per minute.
4. Provide for both particulate (e.g., dust) **and** contaminate (e.g., chemical solvent) removal.
5. Provide, and encourage students to use, adequate masks and respirators for dust and chemical safety. Be certain to match the respirator cartridge to the hazard, e.g., dust, chemicals, fumes. NIOSH/MESA standards apply.

Eye safety

Eye protection is a primary concern in ITE/TE facilities. It requires proper safety attitudes, instruction and equipment. The latter includes impact resistant lenses and eyewash stations in areas (within 15 seconds travel time) where chemicals are used. Splash and mist hazards as well as cleanliness needs must also be attended to. All laboratory entrances should clearly display a poster indicating the need for eye safety procedures. Eye safety protection must meet ANSI Z 87.1-1989 and subsequent revision standards and be marked accordingly.

Eye protection is a primary concern in ITE/TE facilities. It requires proper safety attitudes, instruction and equipment.

Sanitizing Protective Eyewear[1]

A germicidal ultraviolet (UV) cabinet is one method for sanitizing eyewear. The 5- to 15-minute cycle (follow the manufacturer's recommendations) will disinfect susceptible bacteria and viruses from surfaces, though the Missouri Department of

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[1] see Lemmons, 1990 for additional details, including selection of eyewash stations disinfecting solutions, safety glass & contacts information, safety showers.

Health questions whether disinfection is total. The Missouri Department of Health recommends that the UV lamp intensity be checked yearly with a UV meter and the lamp be cleaned weekly or biweekly as the lamp intensity is affected by the accumulation of dust and dirt on it...

UV cabinets are expensive, and the time needed for disinfection is not always available, but some type of sanitizing should be done between each student use, e.g., by wiping with an appropriate cleaner/disinfectant.

The best recommended practice is, of course, for students to each have his/her own safety glasses. This prevents sanitization problems and encourages responsible care. The ITE/TE facility could then include appropriate numbers of specialized eye protective devices such as melter's goggles and face shields.

Recommended Eye Protection for Specific Activities[1]

The following chart offers general recommendations for eye protection applicable in a school setting for students, teachers and visitors. NOTE: Goggles with *direct ventilation* are designed to exclude the direct passage of large particles. Goggles with *indirect ventilation* are designed to exclude the direct passage of dust, liquids, or light. Use only ANSI approved safety glasses. Figure IV-15 describes the hazards and protective devices associated with typical ITE/TE activities.

Generally, most prescription glasses do not meet ANSI standards, nor do contacts provide any protection. However, they and/or approved safety glasses, may be combined with other types of protective devices, e.g., goggles, to obtain the needed or even higher levels or protection. A typical example is the use of full face shields over proper safety glasses. Figure IV-16 illustrates the typical types of eye protection.

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[1] *Industrial technology safety guide*

Figure IV-15

Eye Safety Recommendations[1]

ACTIVITY OR OPERATION	EYE HAZARDS	EYE PROTECTIVE DEVICE(S)
TECHNOLOGY EDUCATION	Flying chips, particles, objects	Spectacles with sideshields, goggles, DV*
General shop/laboratory operations (power, carpentry, electricity, metal work, woodworking, masonry, etc.)	Dust, grease, hot steam, splashing liquids	Goggle, cup or cover type, IV
Lubricating, spray, painting, steam and solvent cleaning, finishing materials	Mists	Goggle, no ventilation
ENERGY/POWER/TRANSP'TN		
General operations	Flying chips, particles, Dust	Spectacles with sideshields or goggles, DV*
		Goggle, cup or cover type, IV
Lubricating, spray painting, steam and solvent cleaning	Grease, hot steam, splashing	
		Goggle, cup or cover type, with IV
Battery Servicing	Acid, sparks, explosion	Goggle, cup or cover type, IV
	Mists	Goggle, no ventilation
	Splashing	
Painting, mixing and chemical preparation		Goggle, cup or cover type, IV
	Mists	Goggle, no ventilation
CONSTRUCTION/PRODUCTION/MFG	Flying chips, particles and objects	Spectacles with sideshields or goggle with DV
General operations		
	Dust	Goggle, cup or cover type, IV
Chemicals, solvents, finishing materials	Mists	Goggle, no ventilation
pickling, etching	Acids, splashing	
	Splashing, pressurized sprays	Goggle, cup or cover type, IV
Kiln firing, dry mixing, glass fritting, throwing	Clay and glaze particles, explosion (firing)	Spectacles with sideshields or goggles, DV*
Core and moldmaking, chipping, grinding, general operations	Chips, flying particles	Spectacles with sideshields or goggles with DV
Heating, melting and pouring metal	Splashing, sputtering	Goggles with tinted plastic lenses and IV and a full faceshield
Silver soldering, chasing and smelting, hammering	Sputtering metal, sparks, flying objects	Spectacles with sideshields or goggles with DV*
Carving, stamping, cementing, buffing	Flying particles	Spectacles with sideshields or goggles with IV*
Electric arc welding	Welding flash, sparks, sputtering, molten metal, air bubble explosions	Welding helmet with filter lens over safety spectacles with sideshields**
Gas welding, cutting, burning and metalizing	Flying sparks and metal	Welding goggles over safety spectacles with sideshields**
Chipping, grinding	Flying chips, slag particles	Spectacles with sideshields or goggles with DV
ELECTRICITY/ELECTRONICS	Flying glass, solder splash	Spectacles,sideshields or goggle with DV
General operation		
Cathode tube servicing	Implosion, flying glass	Spectacles, sideshields or goggle with DV
Chemical etching	Acid , splashing	Goggle, cup or cover type, with IV
COMMUNICATIONS		
Cutting, stitching, drilling	Flying objects	Spectacles with sideshields or goggles with DV*
		Goggle, cup or cover type, with IV
Chemical mixing, solvents	Splashing	
Air brush, spray painting, chemical mixing solvents, photographic solvents	Pressurized sprays	Goggle, cup or cover type, IV
SCIENCE		
Chemical handling, experimenting, glass handling, dissecting, heating	Splashing, flying particles	Goggle, cup or cover type, with IV
Laser experiments	Severe retinal burns, (operators and observers must be protected)	Eye protection devices which are in compliance with ANSI Z136.1-1980
	Splashing, pressurized sprays	
Chemicals, solvents, finishing materials		Goggle, cup or cover type, with IV

*Add face shield for severe exposure. DV = Direct ventilation IV = Indirect ventilation

**See specialized references for selection of shade number of welding filters.

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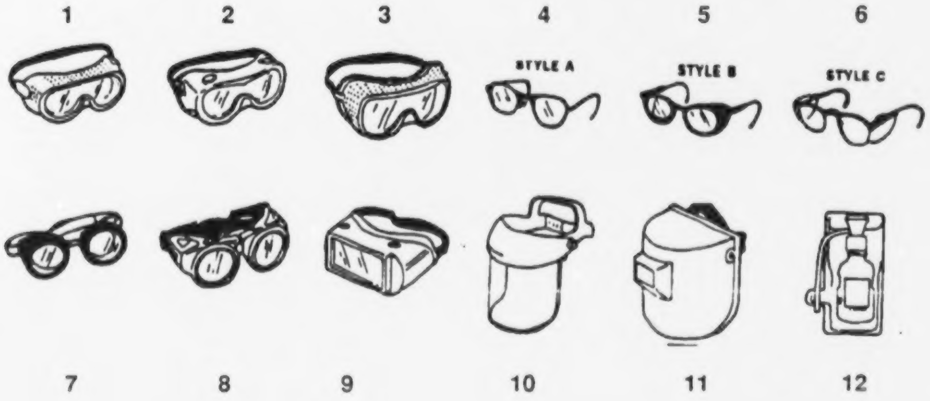
[1] Compiled from *Eye safety* (1990, Hughes (1988), et al.

Figure IV-16

Selection Chart for Eye & Face Protection for Use in Industry, Schools and Colleges[1]



1. GOGGLES, Flexible Fitting, Regular Ventilation
2. GOGGLES, Flexible Fitting, Hooded Ventilation
3. GOGGLES, Cushioned Fitting, Rigid Body
4. SAFETY GLASSES, without Sideshields
5. SAFETY GLASSES, Eyecup Type Sideshields
6. SAFETY GLASSES, Semi-/Flat-Fold Sideshields
7. FILTER LENSES, Eyecup Type, Tinted Lenses (Illustrated)

7A. CHIPPING GOGGLES, Eyecup Type, Clear Safety Lenses (Not Illustrated)

8. WELDING GOGGLES, Coverspec Type, Tinted Lenses (Illustrated)

8A. CHIPPING GOGGLES, Coverspec Type, Clear Safety Lenses (Not Illustrated)

9. WELDING GOGGLES, Coverspec Type, Tinted Plate Lens
10. FACE SHIELD, Plastic or Mesh Window
11. WELDING HELMET
12. EYEWASH EQUIPMENT

Remember - Eye protection does not protect unless it is worn and used properly.

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[1] Adapted from "Selection Chart" American National Standard 287.1-1979, per Jacobs, et. al.

Sharps/Infection Safety[1]

Concern is generally increasing about the possibility of infection and the transmission of disease by cuts and other injuries that might happen in the ITE/TE facility. Because some schools have implemented Sharps policies to address this, the ITE/TE instructor should check with his/her system's authorities to access these policies if they exist. When employed, they typically include recommendations such as:

1. Using special red impervious containers clearly labeled/color coded for the disposal of infectious waste (e.g., Bandaids, items contaminated with human blood or body fluids, etc.) and sharps.
2. Teaching special procedures for the use of sharps (e.g., knives, edge tools, syringes, etc.) and then documenting mastery of them.
3. Providing students with their own sharps (e.g., Xacto blades) to eliminate sharing.
4. Decontaminating sharps between shared use by soaking in 1:10 bleach solution for 30 minutes or wiping with a proper disinfectant. Do not mix solution in advance.
5. Disposing of sharps and contaminated materials in conformance with state laws and local ordinances (if any).
6. Reporting all injuries/incidents that involve blood and/or body fluids to the proper school health authorities immediately.
7. Avoid direct skin contact with body fluids by using rubber gloves (preferably disposable), and cleaning up spills with disposable towels or materials. Wash hand and exposed skin thoroughly after removing gloves.
8. Keeping informed of the Missouri State Board of Education's policy suggestions for communicable diseases.

The keys to protection against communicable disease are:

- Prevention
- **Instruction**
- **Appropriate procedures**
- **Decontamination**
- **Disposal**
- **Record-keeping**

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[1] compiled per input from MODESE Health Occupations Supervisor, the *Missouri Secondary Science Safety Manual* (1990), and Mr. B. Yates, Columbia Public Schools.

Hazardous Materials

When "OSHA" (Occupational Safety and[1] Health Act) is mentioned, teachers in technical and technology subjects might think that once their machines are guarded, the ventilation is right and their paint is stored in a flame proof locker, they are in full conformity with these laws. Wrong! Most forget the newer "hazardous materials" requirements. The areas where teachers are most likely to violate OSHA standards are failing to provide appropriate protective equipment, the use, storage and disposal of hazardous materials, and failing to adequately inform students (and have records) of hazards.

Rapid changes in technology are causing corresponding curriculum changes in technical and technological subjects. These changes increase the use of new and exotic materials, including materials that are classified as "hazardous materials." However, increased liability, research and medical innovations are also placing some traditional materials into the "hazardous" category. Hazardous materials now include most adhesives, solvents, finishing materials, cleaning fluids, liquid plastics, some solid plastics, asbestos and many other items. Hazardous materials can be liquids, gases or solids. Some specific items include ammonia, turpentine, natural gas, liquid petroleum gas, freon, cosmetics, photographic developers, hay, lubricating oil, fuels, sulfuric/hydrofluoric acids used as etchants, and a host of others. In all, the lists include more than 1,800 materials. Using any of these materials in a laboratory automatically obligates the teacher to become aware of the hazards associated with the use of that material and to protect students from such hazards. These include fire hazards and hazards to the environment and to health.

Appropriate protective equipment

Hazards to humans from the handling, use, storage, and disposal of hazardous materials fall into several categories. The main ones, however, are: absorption, contact, and inhalation. These include immediate, short-term and long-term effects. Of course, teachers are typically responsible for the students' safety on those factors that can cause injury from contact or other exposure. School districts become responsible for teacher contact and short-term exposure as well as long-term effects. Disposable paper masks are typically appropriate for paint spray and sawdust. They are inappropriate for other factors. Specific filters must be obtained for organic vapors, acid gases, ammonia and methylamine and for formaldehyde-based materials. Some filters may also require a pre-filter to strain off larger particles before the vapors enter the secondary cartridge. In extreme conditions, a self-contained and completely enclosed helmet that is ventilated from an outside source may be appropriate. These may be required when working with corrosive materials, sand-blasting and some types of welding.

Cloth aprons or lab coats may also pose considerable danger because they may absorb the material and hold it near a person rather than protect them from it. Teachers must be aware of such dangers and provide appropriate splash-proof aprons, gloves and eye wear. Most of these can be obtained as disposable items at relatively low cost.

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[1] Because of its appropriateness, the following article is reported in its majority. Baker, G. E., Dennis, M., & Bouck, L. Beyond OSHA: Hazard communication tips, *Industrial Education*, Oct/Nov 23, 1990, p. 21-24.

Use, storage and disposal of waste

Many of the materials and processes used in a technology/industrial technology education laboratory result in the generation of hazardous waste. Some of this waste could be eliminated by product substitution. For example, oil-based paints and solvents could be replaced by water-based products. Teachers should be aware that, depending on the type and quantity of the waste generated, federal, state, or local disposal regulations may apply (Hughes, 1987, p. 32).

Teachers should use materials when they carefully follow the conditions specified on the label. These conditions should detail factors such as recommended ventilation, protective clothing, or special handling and use techniques. Teachers should not ignore these directions because ignoring them is an automatic assumption of any liability for an accident, as well as being dangerous.

In most school situations, one metal fire-proof cabinet is provided for flammable materials. If all of the materials stored in such a cabinet are similar items or chemical composition, then it is probably all right to store them there. However, some dissimilar materials may emit vapors that interact to start chemical combustion. It is best to always check **and never assume** that anything put into the "flammables" cabinets is safe.

Another commonly overlooked situation is in the disposal of hazardous wastes. Teachers have been known to pour solvents and other materials down sink drains, onto driveway surfaces, and into storm drains. All of these actions are in violation of the Hazardous Materials Act or the Environmental Protection Act. Even small amounts of some materials can create fire/explosion hazards in sewers and drains, or harm the environment. Schools should provide an officer for disposal of hazardous materials—often the transportation officer responsible for bus and vehicle maintenance in the schools.

Failure to inform students & maintain records

Using materials in a school lab implies that the person who made the decision to use the material also assumes the responsibilities for informing the user of all hazards and for the storage and disposal of that material. Schools are exempt from OSHA requirements, but teachers are not exempt from the liability of prudent and responsible behavior. To be free of liability, teachers must be able to show that they used the best reasonable and prudent behavior and thus were able to foresee and prevent the likelihood of accidents. Teachers are obligated to model their actions, facilities, use, storage and disposal practices after the "best school practice" and "appropriate industrial" practices. Teachers must also consider compliance with local fire codes.

Teachers should be aware of potential hazards in their facilities and use the most current hazard exposure information so that they can make the best efforts to comply with OSHA standards. In addition, teachers need to leave a "paper trail" to be able to prove with documentation that reasonable foreseeability has been used to prevent exposures to hazards and accidents.

Regarding individual students, teachers may be held responsible in the event of an accident.... Therefore, the teacher must show that they were not negligible and that the accident was the result of either unpredictable circumstances or an error by the student....

The best model that the teacher can use for reasonable and prudent action is the industrial standard, or the OSHA codes. Under the OSHA guidelines, employers (teachers) are required to:

(1) inform each employee (student) of the hazards involved and the correct procedures for handling, use, storage and disposal of the hazardous material; (2) keep written records indicating that they have indeed informed their employees (students); (3) clearly label all containers for content, hazard and procedures; and (4) keep emergency information on hand for each hazardous material used.

Information sources[1]

Teachers may immediately ask themselves where to find the necessary information now that they have to provide instruction and maintain records. They may also ask "is the material being used hazardous?". The information is required by law to be on the container, but of course, shipment and handling may dislodge the label or render it unreadable. What should the teacher do?

There are several sources of information for finding if a material is hazardous or not. The containers are supposed to be labeled with the required information. If not, perhaps the easiest and quickest procedure would be to ask the dealer, salesperson or product supplier for the information. If that does not work, and the common name or the chemical name of the material is known, a check with city fire officials may provide certain information. The Department of Transportation (DOT) provides lists of materials with appropriate information as to their handling, etc. The guide is cross referenced with groups of materials that have similar characteristics. Some city libraries may have these materials, fire departments will typically have emergency response information and some trucking associations may have them. They are also available from the Department of Transportation and the government printing office. Further lists are published yearly in an annual update by the Occupational Safety and Health Administration. Most large school systems also have a safety officer or someone who is in charge of providing safe instruction to teachers and employees.

The teacher must remember that their actions must be reasonable and prudent as judged by comparable practices in good schools or by the industrial model. This means that teachers can show that they exercised reasonable foreseeability considering the probable actions of students in any given situation; and that students did actually receive the instruction. Thus, the best course of action for teachers is to maintain records that show the date and the information presented to the students. Furthermore, some student response showing that the student understands is considered desirable. A response may be a test, an open book test, a study sheet, or something relating to the transport, handling, use, storage and disposal of the hazardous material. If teachers will become knowledgeable about hazards, educate their students properly and implement good procedures in storing, handling and disposing of materials, violations should be minimized. Thus, going "beyond OSHA" will provide peace of mind as well as reduction of risk.

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[1] Editor's note: Lemmons (1990). *The Missouri secondary science safety manual's* Appendix C lists an extensive list of incompatible chemicals for example. Appendix D provides details of selected dangerous chemicals.

Disposing Hazardous Materials In Missouri

The Missouri Department of Natural Resources (DNR) has developed a program to help schools dispose of unwanted chemicals. Public school districts are considered as state agencies so the schools can utilize a statewide service contract titled "Hazardous Substance Disposal Services." Each school district is required to pay all costs for the disposal of its waste chemicals. The school district sends an inventory of unwanted chemicals to each of three listed disposal companies, and a cost estimate for on-site packing, removal, transport, and disposal of the chemicals is returned. The school district works directly with the disposal company.

Most hazardous substances from the art, industrial arts, and custodial departments may be included in this disposal program.

Smaller schools may save money by pooling inventory lists with other schools or districts when asking for estimates from the participating disposal firms. Schools may also use this program for disposal of laboratory wastes on a semi-annual or annual basis, after the initial storage room cleanup. This plan will help school save money because of the competitive bidding, and will reduce the amount of paperwork required by a school for appropriate chemical disposal.

Contact the Missouri Department of Elementary and Secondary Education at (314) 751-9069 or the Missouri Office of Administration at (314) 751-4169 for more information (Lemmons, 1990, p. 25)

Materials Safety Data Sheets

Materials Safety Data Sheets (MSDS) are an important element of safety in the ITE/TE laboratory. All teachers should compile a comprehensive list of hazardous materials used in their laboratories. Figure IV-17 provides a sample inventory form for this purpose. Teachers should request MSDS from the suppliers of these materials and then compile them in a readily accessible binder.

The MSDS provides crucial information needed to teach safety and handle emergencies properly. A sample is provided in Figure IV-18: Section I lists key supplier and emergency contact information. Section II details the hazardous ingredients. Section III highlights physical and chemical characteristics and Section IV the fire and explosion data, the latter section also containing fire fighting recommendations, while Section V presents reactivity data indicating dangerous combinations of materials. Section VI summarizes the most important health information. Very importantly, Section VII provides precautions for safe handling and use that should be taught to all students—including proper disposal! Finally, Section VIII lists control measures such as appropriate personal protective equipment. Do not handle any materials until you read and understand the label and its MSDS.

Figure IV-17

Hazardous Material Inventory Form

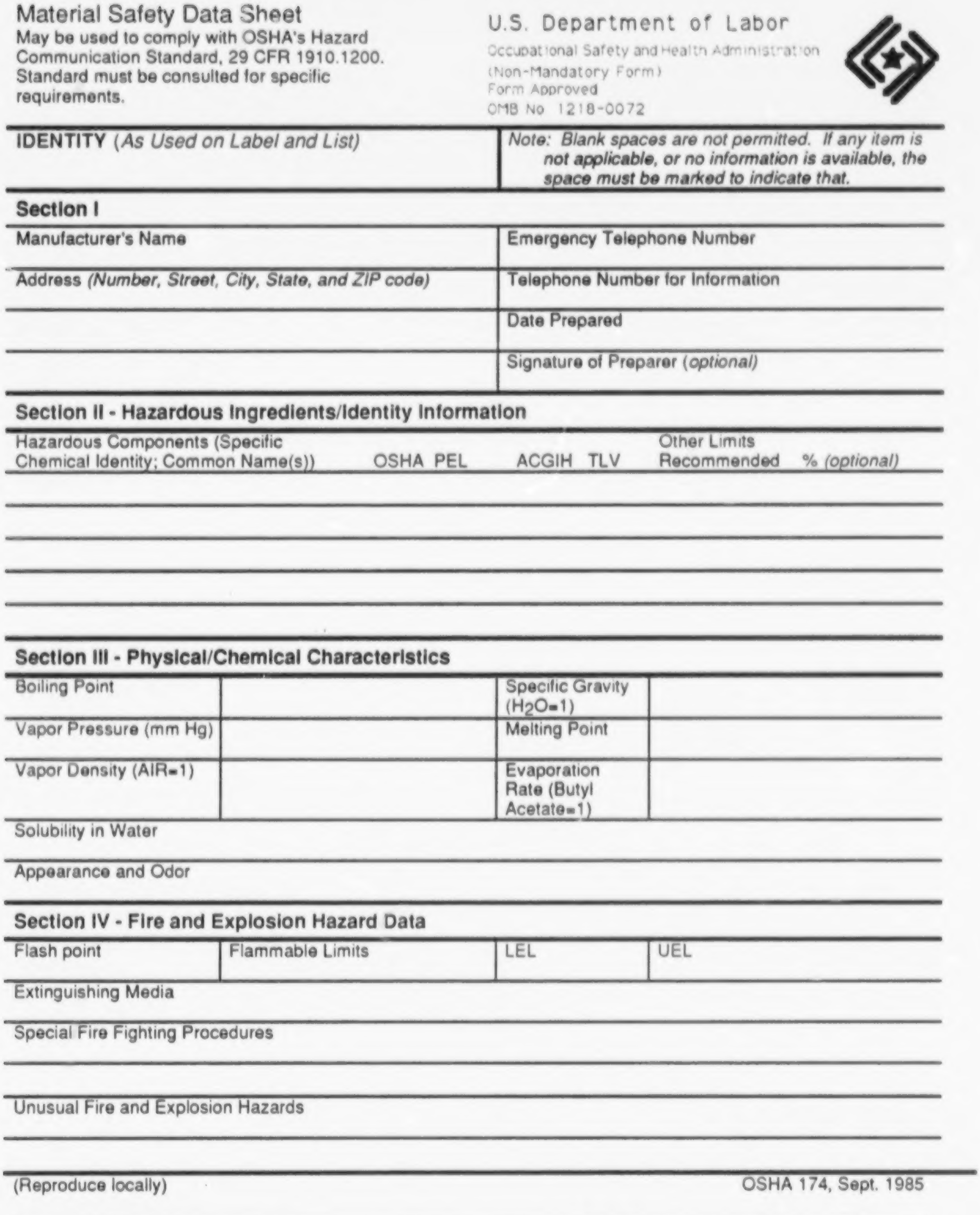
Teacher: ________________ Laboratory:_____________ Date: ____________

School: _________________ Course: ___________________________________

Item #	Hazardous Material & Quantity	Location	Source	Hazards	Precautions	Methods of Disposal (Code)
1.						
2. 3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						

Figure IV-18

Material Safety Data Sheet



Material Safety Data Sheet
May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No 1218-0072

IDENTITY *(As Used on Label and List)*	*Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.*

Section I

Manufacturer's Name	Emergency Telephone Number
Address *(Number, Street, City, State, and ZIP code)*	Telephone Number for Information
	Date Prepared
	Signature of Preparer *(optional)*

Section II - Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% *(optional)*

Section III - Physical/Chemical Characteristics

Boiling Point		Specific Gravity (H_2O=1)	
Vapor Pressure (mm Hg)		Melting Point	
Vapor Density (AIR=1)		Evaporation Rate (Butyl Acetate=1)	
Solubility in Water			
Appearance and Odor			

Section IV - Fire and Explosion Hazard Data

Flash point	Flammable Limits	LEL	UEL
Extinguishing Media			
Special Fire Fighting Procedures			
Unusual Fire and Explosion Hazards			

(Reproduce locally) OSHA 174, Sept. 1985

Section V - Reactivity Data

Stability	Unstable		Conditions to Avoid
	Stable		

Incompatibility *(Materials to Avoid)*

Hazardous Decomposition or Byproducts

Hazardous Polymerization	May Occur		Conditions to Avoid
	Will not Occur		

Section VI - Health Hazard Data

Route(s) of Entry:	Inhalation?	Skin?	Ingestion?

Health Hazards *(Acute and Chronic)*

Carcinogenicity:	NTP?	AIRC Monographs?	OSHA Regulated?

Signs & Symptoms of Exposure

Medical Conditions Generally Aggravated by Exposure

Emergency and First Aid Procedures

Section VII - Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled

Waste Disposal Method

Precautions to Be Taken in Handling and Storing

Other Precautions

Section VIII - Control Measures

Respiratory Protection *(Specify Type)*

Ventilation	Local Exhaust	Special
	Mechanical *(General)*	Other
Protective Gloves		Eye Protection

Other Protective Clothing or Equipment

Work/Hygienic Practices

☆U.S.G.P.O.: 1986-491-529/45775

Inspections

A safe environment is an essential part of a safety program. A safe environment will exist only if hazards are discovered and corrected through regular and frequent inspections by school personnel-administrators, safety coordinators, insurance and fire personnel, teachers and students, state supervisors, university faculty, and service area specialists. It is recommended that the ITE standards, provided in Figure IV-19, be used to guide such inspections. Depending upon the type of shop/laboratory or circumstances involved in each case, safety inspections by several persons might be necessary. The ITE/TE teacher should also be making a constant safety inspection as he/she goes through daily routines—always alert to changing conditions or work methods. In most cases, teachers need to make hourly checks and inspections to be certain that all safety precautions are in place.

> **It is recommended that the ITE standards, provided in Figure IV-19, be used to guide such inspections.**

A safety inspection/checklist is an objective tool to help improve working and learning conditions in the laboratory. Using a detailed safety checklist, such as the one developed by the National Safety Council for the inspection, has some advantages over other methods. A sample page is provided in Figure IV-20. Teacher may also wish to prepare a special safety inspection checklist tailored to their own situation. A sample is shown in Figure IV-21. Such checklists serve several purposes in that they:

- inform, educate and remind persons of key characteristics of safe environments.
- train personnel to be sensitive to, observant of, and aware of their environment.
- provide a source of feedback to teachers and administrators that indicates the extent to which the ITE/TE facility is a safe environment.
- provide a record of safety items and prevention activity.

Reasons for Inspections

There are eleven excellent and specific reasons for conducting safety inspections:

1. To promote interest in safety by making displaying sincerity relative to safety.
2. To reevaluate and improve safety standards and policies.
3. To teach safety by specific, tangible example.
4. To detect and reactivate unfinished business.
5. To collect current safety data for up-to-the-minute reporting.
6. To note and act upon unsafe behavior trends.
7. To reach first hand, on-the-spot agreements with responsible parties relative to securing action on safety problems.
8. To check new and rearranged facilities for student accessibility
9. A conference of the inspection team, the instructor and appropriate administrators should be held shortly following the inspection of each practical arts and vocational technical facility.

Who should inspect?

Part of the answer to "who inspects?" is based upon the fact that, in most cases, there should be more than one type of safety inspection. Depending upon the type of shop/laboratory or circumstances involved in each case, safety inspections by several persons might be necessary. The teacher should be making a constant safety inspection as he/she goes through daily routines—always alert to changing conditions or work methods. In most cases, teachers need to make hourly checks and inspections to be certain that all safety precautions are in place.

For overall assessment, in-depth safety inspections of the industrial technology/technology education facility should be made at least annually by state and/or local school personnel and, for learning purposes, by a student safety committee team. The building principal would ideally be a member of the team.

Inspections by the members of a safety committee may reveal hazards which might be overlooked by persons less familiar with the work. Some committees make inspections each month; others may inspect every other month or even once per semester. In all cases, more than one person should make the safety inspections.

Typically, the following people are available to offer and perform inspections:

- MO DESE supervisors
- University professors
- Insurance inspectors
- Other ITE/TE instructors
- Local fire department personnel
- State Department of Labor safety specialist
- State Safety Council representatives

Recommendations for the use of checklists

1. A safety inspection team should complete a checklist for each industrial technology/technology education laboratory and compare the findings with previous reports to ascertain progress.
2. The inspection team may arrange for additional assistance from outside agencies to help with safety inspections. Such assistance might be obtained from insurance or fire inspectors, advisory council members, and/or governmental agencies such as the Missouri Department of Labor Standards.
3. As a minimum, safety inspections should be made at the beginning of every school term. More frequent inspections may be advisable in critical areas.
4. Inspections should be planned in advance and preferably should occur when students will be using the facility.
5. Inspection should be studied in terms of accident reports so that special attention can be given to aspects which are accident producers.
6. In all cases when corrective actions are required, they should be noted and copies forwarded to the proper authorities.
7. Each unsafe condition should be corrected as soon as possible in accordance with accepted local procedures and with due regard to the hazard potential of the situation.

Figure IV-19

MO ITE Standards, Topic 9: Safety and Health

The goals of technology education and/or industrial technology will require that laboratories be designed to accommodate tools, equipment, materials and unique instructional strategies that represent today and the future. Safety and health must remain a high priority as laboratories are designed and re-designed to accommodate change to reflect new technologies. A comprehensive safety & health program is essential to the success of a quality industrial technology/technology education program that provides a safe environment and promotes lifelong safety & health attitudes and practices.

Standard not met = ∇ Standard met = 0 Standard exceeded = Δ

1. Teachers prepare a written plan for a comprehensive safety & health program. .... ∇ 0 Δ
2. Administrative personnel provide input for & approval of the safety & health program. .... ∇ 0 Δ
3. Community, resources, including the industrial technology/technology education advisory committee, provide input to the safety & health program .... ∇ 0 Δ
4. Local, state, and national safety & health literature and regulations are utilized in planning the safety & health program. .... ∇ 0 Δ
5. Safety & health information is included in instruction for all laboratory activities. .... ∇ 0 Δ
6. Teacher and student activities reinforce safety & health instruction.................................... ∇ 0 Δ
7. Safety & health instruction is adapted to individual student needs.. ∇ 0 Δ
8. Teachers monitor continuously and review annually the safety & health practices............... ∇ 0 Δ
9. Local administrators assess and make recommendations for the improvement of the safety & health program.. ∇ 0 Δ
10. Proper authorities, external to the school, inspect periodically and report on the safety & health program... ∇ 0 Δ
11. Students demonstrate acceptable knowledge, skills, and attitudes of safety & health practices and rules through written and performance tests, and in-class behavior .... ∇ 0 Δ
12. Teachers and administrators review each recorded accident and all unsafe practices to correct deficiencies.. ∇ 0 Δ
13. Classroom and laboratory facilities meet safety & health laws and regulations. .... ∇ 0 Δ
14. Safety zones and aisles are properly marked.. ∇ 0 Δ
15. Lavatory facilities for both sexes are provided near or in the industrial technology/technology education laboratory.. ∇ 0 Δ
16. Lighting is appropriate for the activities performed within the facility.............................. ∇ 0 Δ
17. Proper exhaust system equipment which removes fumes, chips, and dust from the building is provided, as needed. .... ∇ 0 Δ
18. Noise levels within the laboratory do not exceed acceptable limits. .... ∇ 0 Δ
19. Proper equipment is provided to heat, cool, or ventilate all instructional and ancillary areas, as needed. .... ∇ 0 Δ
20. Approved safe cabinets, containers, or rooms are provided to store flammable and corrosive materials. .... ∇ 0 Δ
21. Special safety & health accommodations are provided for students with special needs, as required... ∇ 0 Δ
22. Floors and all other surfaces are kept free of waste material, grease, and obstructions, as needed... ∇ 0 Δ
23. Floors have non-skid surfaces, with special treatment of machine-operator areas........ ∇ 0 Δ

Figure IV-19: MOITE Standards, Topic 9: Safety and Health (Continued)

Standard not met = ∇ Standard met = 0 Standard exceeded = Δ

24. Each laboratory with powered equipment has the equivalent of one easily accessible emergency disconnect switch (panic button) per perimeter wall. .... ∇ 0 Δ
25. Fire extinguishers of the correct class are provided in appropriate locations.................. ∇ 0 Δ
26. A first-aid kit and related emergency supplies are provided in accordance with local regulations. .... ∇ 0 Δ
27. Equipment which satisfies state and federal regulations is selected on the basis of the ability to meet program objectives safely. .... ∇ 0 Δ
28. Machines and tools are placed, mounted, if necessary, and arranged in a safe and functional manner. .... ∇ 0 Δ
29. All machines and power tools are provided with approved commercial guards and safety devices.................. ∇ 0 Δ
30. Safety guards remain in place, except when the machine is disconnected for cleaning, repair, or adjustment.................. ∇ 0 Δ
31. Any unsafe machine or tool is removed from service and marked accordingly. .... ∇ 0 Δ
32. Color-coding schemes for safety purposes are used throughout the technology education/industrial technology laboratory.................. ∇ 0 Δ
33. Conveniently located magnetic control switches and/or control boxes and braking devices are provided for appropriate machines. .... ∇ 0 Δ
34. Lockable master switch boxes are located in each industrial technology/technology education laboratory. .... ∇ 0 Δ
35. State or federally approved eye protection devices are required of all persons exposed to conditions which may cause eye injury.................. ∇ 0 Δ
36. State or federally approved ear protection devices are required of all persons exposed to conditions which may cause ear damage. .... ∇ 0 Δ
37. State or federally approved respiratory protection devices are required of all persons exposed to conditions which may cause respiratory problems. .... ∇ 0 Δ
38. State or federally approved head protection devices are required of all persons exposed to conditions which may cause head injury. .... ∇ 0 Δ
39. Specially adapted personal protection devices are available for and used by students with special needs, as needed.................. ∇ 0 Δ
40. Teachers and students wear appropriate clothing when exposed to conditions which warrant such protection.................. ∇ 0 Δ
41. Personal protection devices requiring sanitation are sanitized after each use.................. ∇ 0 Δ
42. Corrective and preventive maintenance is performed within a reasonable time following written notification to the appropriate administrator.................. ∇ 0 Δ
43. Lesson plans documenting provision for safety & health instruction are on file. .... ∇ 0 Δ
44. Results of written and performance tests and observations documenting student safety & health knowledge, attitudes, and skills are on file. .... ∇ 0 Δ
45. Inspection, maintenance, repair, and replacement records are current and on file, as required. .... ∇ 0 Δ
46. Records of each accident and the follow-up procedures taken are on file.................. ∇ 0 Δ
47. Emergency procedures for responding to accidents are posted and on file.................. ∇ 0 Δ

Total ∇ ➔ ____ ➔ **Total** 0 ➔ ____________ ➔ **Total** Δ ➔ ____________ ¶

Figure IV-20

Safety Inspection Checklist (Sample Page)

NATIONAL STANDARD SCHOOL SHOP SAFETY INSPECTION CHECKLIST[1]

Introduction

A safe environment is an essential part of the school shop safety education program. The safe environment will exist only if hazards are discovered and corrected through regular and frequent inspections by school personnel—administrators, teachers and students. Safety inspections are to determine if everything is satisfactory. Inspections may be made at the request of the board of education, the school administration or upon the initiative of the teacher. Some communities have drawn upon the cooperative service of professional safety engineers, inspectors of state labor departments, insurance companies and local safety councils to supplement and confirm inspections by school personnel. The National Standard School Shop Safety Inspection Checklist, recommended by the President's Conference on Industrial safety, is an objective inspection procedure for the school shop.

Directions

Who Inspects? This will depend upon local policies. It is recommended, however, that shop teachers and students—the student safety engineer and or student safety committee-participate in making regular inspections. This not only tends to share responsibility but stimulates a broader interest in the maintenance of a safe school shop.

When to Inspect? As a minimum a safety inspections should be made at the beginning of every school term or semester. More frequent inspections may be advisable.

How to Inspect? Inspections should be well planned in advance. Inspections should be systematic and thorough. No location that may contain a hazard should be overlooked. Inspection reports should be clear and concise, but with sufficient explanation to make each recommendation for improvement understandable.

Follow-up The current report should be compared with previous records to determine progress. The report should be studied in terms of the accident situation so that special attention can be given to those conditions and locations which are accident producers. Each unsafe condition should be corrected as soon as possible in accordance with accepted local procedures. A definite policy should be established in regard to taking materials and equipment out of service because of unsafe conditions. The inspections report can be used to advantage as the subject for staff and class discussion.

Checking Procedure

Draw a circle around the appropriate letter, using the following letter scheme: S—Satisfactory (needs no attention); A—Acceptable (needs some attention); U—Unsatisfactory (needs immediate attention).

Recommendations should be made in all cases where a "U" is circled. Space is provided at the end of the form for such comments. Designate the items covered by the recommendations, using the code number applicable. In most categories, space is provided for listing of standards, requirements or regulations which have local applicability only.

A. GENERAL PHYSICAL CONDITION

1. Machines, benches and other equipment are arranged to conform to good safety practices. ..... S A U
2. Condition of stairways .... S A U
3. Condition of aisles .... S A U
4. Condition of floors .... S A U
5. Condition of walls, windows and ceilings .... S A U

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[1] Prepared by the Joint Committee of the American Vocational Association – National Safety Council.

Figure IV-21

Local School Safety Checklist[1]

	Satisfactory	Un-satisfactory	Not Applicable
Environmental Factors			
1. All lights are operable and of sufficient intensity			
2. Aisles and safety zones are marked and clear			
3. Emergency power switches are unobstructed			
4. Fire extinguishers are unobstructed, in the proper locations, in working order, and of the proper kind			
5. No accumulation of rubbish			
6. Trash containers are emptied			
7. First aid kits in proper location, well-supplied, and identified			
8. Air and ventilation are adequate			
9. Other			
Tools and Equipment			
1. Hand tools are sharp; properly stored; in good working order; and free from dirt or grease			
2. Power machines properly lubricated; properly adjusted; guards are in place and properly adjusted; cutting edges are sharp; wires, plugs, and connectors are good; and hoses and valves are good			
3. Automated equipment: cables are neat; wire is not frayed; limit switches are operable; and emergency switch is operable			
4. Personal protective equipment exists in good condition and of sufficient type and number			
5. Other			
Materials & Storage			
1. Storage areas are clean and neat			
2. Racks and containers are not over filled			
3. Hazardous objects are stored on lower shelves			
4. Racks are properly designed for stored materials			
5. Fire and chemical safety is provided for			
6. Other			

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[1] Adapted from Deluca & Haynie (1989).

11. Technology Equipment Safety[1]

Model Rocket Safety

1. No fire hazard should be posed by the launch. This means no dry vegetation or forest areas may be within the launch radius.
2. No buildings, other structures, roads, or high voltage electrical lines may be within the launch radius.
3. Do not allow students too close to the firing area.
4. Do not launch other than commercially produced rocket engines of known size and predictable range.
5. The firing area should be at the center of the launch radius. In no case should it be closer than 25 feet (8 m) to the boundary of the launch site.
6. Teachers should caution their students regarding the dangers of experimentation with rockets and missiles, especially with respect to the preparation and use of noncommercial rockets and propellants.
7. Teachers must refrain from providing chemicals for rockets or missiles or helping students to obtain them.
8. Avoid using, or permitting to be used, liquid or solid fuels in the classroom, as such use constitutes essentially a controlled explosion.
9. Permit the construction of rockets, missiles, or component parts in the classroom or shop only in accordance with safety rules such as those distributed by the Model Rocket Association and/or Estes Inc.

Laser Safety

Industrial technology/technology education and science teachers should be aware of the inherent dangers to personnel which accompany the operation of lasers. Their use in demonstrations or in research activities must be preceded by orientation of all involved personnel to the potential hazards.

The United States Center for Devices and Radiological Health (CDRH) regulates the manufacturers of lasers to see that users are not endangered. The federal government classifies lasers according to their power levels and specifies appropriate safety features for each level. Demonstration lasers fall into class II and can be identified by a yellow "CAUTION" label which contains the warning "Do not stare into beam".

In addition to the CDRH label, each laser should have the following label placed near the beam exit: "Avoid exposure. Laser light is emitted from this aperture." The CDRH also requires that manufacturers provide users with the following information: "Caution—Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous light exposure."

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[1] Appreciation is expressed to Hughes (1988), Lemmons (1990), Graymark, et al., and the states of Kansas, Connecticut, Ohio, Pennsylvania, California, Maryland, New Jersey, Washington, Idaho, Texas, Delaware, Virginia, and Georgia, who have worked to compile contemporary safety precautions and make them available to the profession.

Despite the potential hazard, lasers are valuable sources of light for exciting demonstrations and laboratory experiments in school. Helium-neon lasers emit a beam of visible orange-light. Invisible, exotic, or otherwise harmful radiations are not emitted.

School lasers tend to be low-power lasers. With a light output of only a few thousandths of a watt, these lasers should not be confused with the powerful lasers intended for burning, cutting and drilling.

Even though the power of a laser may be low, the beam should be treated with caution and common sense because it is intense and concentrated. The greatest potential for harm with lasers is to the eyes. No one should look directly into the laser beam or stare at its bright reflections, just as no one should stare at the sun or arc lamps. Class II lasers have a maximum power of 1.0 mW, a power judged to be eye-safe, except possibly in the case of deliberate, long-term direct staring into the beam. Safety features include a pilot lamp which glows when the electrical power is "ON" and a mechanical beam stop which blocks the beam when the power is on.

LASERS are grouped into four basic categories; however, it is suggested that only CLASS I and CLASS II LASERS be considered safe for industrial arts/technology education laboratory usage.

CLASS I. Exempt LASERS or systems: these units, under normal operating conditions, cannot emit a hazardous level of optical radiation. No warning label or control measure is required[1].

CLASS II. Low power LASERS: Visible beams that do not have enough output power to injure a person accidentally. However, prolonged exposure (such as being stared at by an individual) may produce retinal injury. Caution label required.

Lasers with outputs greater than one milliwatt present additional hazards. Schools using such lasers might benefit from the following reference: *Safe use of lasers*, Z136.1, 1986, American National Safety Institute, 1430 Broadway, New York, NY 10018; price $30 plus $5 shipping and handling.

For lasers purchased prior to August, 1976, the optical power specification is not a reliable index of the output. Tests have shown that pre-August, 1976, lasers rated at 1.0 milliwatts radiated in the range of 0.19 to 3.0 milliwatts. Laser hazards may be avoided by implementing the following measures:

1. Avoid direct viewing of the laser beam or using binoculars or telescope with it. Direct propagation of the laser beam from the laser into the eye of an observer should be avoided at all times. As a general practice, do not place any portion of the body in the beam. This practice becomes increasingly important as the output power of the laser device increases. Good work practices, developed early, will later assist the individual in working safely with higher output units.
2. Remove unnecessary objects from the path of the beam. Objects with mirrorlike finishes (e.g., plumbing fixtures) reflect laser beams. Viewing the

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[1] Olishifski, J. B. (Ed.). (1989). *Fundamentals of Industrial Hygiene*. Chicago, IL: National Safety Council.

reflected beams should be avoided. Demonstration equipment, such as support rods and bench surfaces, should be painted or treated to produce a dull, nonreflective surface. All optical components should be rigidly fixed with respect to their position relative to the laser.

3. Block the beam when it is not needed. Use a mechanical beam shutoff to allow the beam to radiate only when necessary for measurements or observations.
4. Terminate laser beams. All laser beams should be terminated in a nonreflective, light-absorbing material.
5. Prepare and test demonstrations without others present. Demonstrations should be prepared and tested by the instructor without others present. The possibility of an unexpected reflection should always be considered.
6. Deflect beam in a vertical plane. Complex experiments or demonstrations involving reflection or refraction should be conducted with the beam deflection angles contained in a vertical plane. The laser display system should be contained in a box, open on the side(s), but closed on the ends, top and bottom. The laser beam axis should be established at a level below or above the eye-level height of the instructor or observer. If the beam must travel a long distance, keep it close to the ground or high overhead so that it does not cross walkways at eye level.
7. Affix expanding lenses rigidly to the laser. When the laser is used to illuminate large surfaces, as in the viewing of holograms, beam-expanding (diverging) lenses should be rigidly fixed to the laser.
8. Equip laser with a key switch in the primary power circuit, rather than with the more commonly used toggle-type switch. Key switches are available from electronic supply stores for a relatively small charge. An additional switch which requires constant pressure is also desirable.
9. Do not leave an operable laser accessible or unattended. Students should operate lasers only with instructor's presence and after they have received instruction.
10. Reduce optical power. The optical power used should be reduced to the minimum necessary to accomplish the objective. Neutral density filters or colored plastic can be used effectively to reduce radiated optical power.
11. Keep the area well lighted at all times. This tends to keep the pupil of the eye relatively contracted and reduces the light impinging on the retina accidentally when the laser system is on.
12. Provide and use adequate eye protection devices. Eye protection with shatter-resistant goggles is essential for some types of laser systems, but no one type of goggle offers protection for all wavelengths. Make sure that proper goggles are available and used per ANSI Z136.1-1980 or newer.
13. Protect against electrical shock. The possibility of electrical shocks from both high-voltage and low-voltage equipment, including storage capacitors and power supplies, can be avoided by proper design. Each laser should be equipped with a UL-approved line cord and a three-prong grounded plug. ALWAYS PLUG THE LASER INTO A GROUNDED OUTLET.
14. High-intensity light generated by the pump source should not be viewed directly. Shielding of the pump source is essential.
15. Others in the area must be warned prior to operation of the LASER.
16. Follow all of the manufacturer's procedures and safety rules.

17. Instruct users as to potential eye hazards and the importance of limiting unnecessary exposure.
18. Appropriate warning sign(s) should be posted in the facility. Such signs might read: LASER BEAM IN USE, DO NOT AIM LASER BEAM AT SURFACES THAT MAY REFLECT IT, …
19. Combustible materials stored in the laboratory should be protected from the LASER beam.

Small Engine Analyzer/Dynamometer

Dynamometers can be of the electrical, fluid or mechanical type. All involve large loads, rotating parts, possible pinch-points and related dangers. In addition, the hazards associated with internal combustion engines are present. Some of the basic safety guidelines include:

1. Operate only with instructor's permission and after you have received instruction.
2. Remove jewelry, eliminate loose clothing and confine long hair.
3. Make sure all guards are in place and operating correctly.
4. Always use proper eye protection.
5. Utilize unit only with proper exhaust ventilation system.
6. Exercise caution when handling fuel, filling fuel tank, wipe up all spillage. Inspect fuel system frequently for defects.
7. Make sure all engines have proper lubrication and are mounted securely.
8. Utilize caution while operating and after operation, because engine will be hot.
9. Insure the dynamometer is mounted securely to the workbench or that its casters are locked.
10. Avoid contact with hot surfaces.
11. Insure that appropriate fire extinguishers are close by.

Biotechnologies

This newly emerging area of ITE/TE presents many safety concerns that have been addressed by science teachers. Details may be obtained by reviewing the *Missouri Science Safety Manual* (Lemmons, 1990). Some of the key points include:

1. Cleaning working surfaces after each experiment with a solution of household bleach and water (1:10) or other cleaner/disinfectant appropriate to the materials employed.
2. Requiring the use of gloves, laboratory coats, and eye protection (splash proof).
3. Carefully checking out activity safety implications with experts—prior to acquiring the materials.
4. Cleaning up broken glassware without touching it. Don't use chipped glassware.
5. Purchasing only school-approved electrophoresis kits and following all manufacturer's safety recommendations.
6. Reviewing all MSDS information for the materials being used.
7. Keep chemicals in locked cabinets, fire safe where necessary.

Robots

Automated equipment and robots are powered-mechanical equipment, so the same safety precautions observed while operating any power equipment should be followed when operating a computer-controlled machine. In some respects, automated equipment can be safer than standard equipment because the user is often removed from the point of processing; however, in many ways automated equipment can also be more dangerous. Since users are less involved during processing, they can easily become distracted and lose concentration. There is no physical feedback, so potential machine failure is difficult to detect and unanticipated programming or communication errors can result in machine failure, tool or part breakage, robots striking objects or people, and other hazards.[1] When using robots or other automated equipment:

1. Be aware of the tool limits or robot work envelope. The movement of the machine during the process is not directly controlled by the operator, so special caution must be taken to insure safe operation. The use of guards with emergency shut-off switches which trip when the guards are opened is a good method to prevent injury.
2. Keep cables neat and inspect connections periodically. Poor connections or signals induced by overlapping wires can cause errors in data flow between the controller and the machine, causing erratic machine movements.
3. When programming a computer-controlled machine, check machine movement using the "step" option on the controller. This option allows the user to individually check each program line, avoiding situations in which incorrect programming creates hazards.
4. There are usually two emergency shut-off systems on CNC and robotic equipment—a mechanical power-off switch and a soft-switch which immediately stops program execution. Be sure students are aware of both systems. Sometimes, quick reaction is necessary to prevent injury or machine damage.
5. Operate robots only with instructor's permission and after having received instruction.
6. Remove jewelry, eliminate loose clothing and confine long hair.
7. Make sure all guards are in place and operating correctly.
8. Always use proper eye protection.
9. When in the teach mode, use slow movements to jog the arm from point to point.
10. Be sure the emergency stop button is functioning properly by testing it early in the teach cycle.
11. Care should be taken that the operator's fingers and other body parts are kept out of the robot's work envelope.
12. The operator must **understand** the intended program of robot actions and motions prior to use of the robot.

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[1] *Safety system design.*

CNC Equipment

1. Operate only with instructor's permission and after you have received instruction.
2. Remove jewelry, eliminate loose clothing, and confine long hair.
3. Make sure all guards are in place and are working properly.
4. Always use proper eye protection.
5. Make certain safety switch is off before setting up machines or making adjustments.
6. Make sure work piece is mounted or clamped securely.
7. Check spindle rotation, speed, depth of cut and all power feed adjustments before starting the cut.
8. Brush away chips and shavings only when machine is stopped. Use a brush, never the fingers.
9. Keep set-up tools off machinery and out of work area.
10. Remain with the machine for the duration of its operation. Do not allow it to work unattended.

Plastics Technology Equipment

1. Operate only with instructor's permission and after you have received instruction.
2. Remove jewelry, eliminate loose clothing and confine long hair.
3. Make sure all guards are in place and operating correctly.
4. Always use proper eye protection.
5. Typically, these machines operate with heating units—use with caution.
6. Do not over heat—match heat/time cycle with material being used.
7. Observe and stay clear of pinch points.
8. Do not over-pressure injection molder ram.
9. Wear heat-resistant gloves and never touch molten plastic.
10. Operate only in properly ventilated area.

Hydraulic Training Unit

1. Operate only with instructor's permission and after you have received instruction.
2. Remove jewelry, eliminate loose clothing and confine long hair.
3. Make sure all guards are in place and operating correctly.
4. Always use proper eye protection.
5. Clean up all fluid spillage.
6. Exercise caution when disconnecting fluid system.
7. Make sure all components are securely fastened and properly connected before operating unit.
8. Do not disconnect components while the system is pressurized.

Electric Discharge Machine (EDM)

1. Operate only with instructor's permission and after you have received instruction.
2. Remove jewelry, eliminate loose clothing, and confine long hair.
3. Make sure all guards are in place and operating correctly.
4. Always use proper eye protection.
5. Observe the tool voltage (300+ volts) and keep clear of all charged areas.
6. Be sure to discharge the tool at the end of a cut.
7. If you spill oil, clean it up.
8. Do not activate the power supply until the dielectric covers the workpiece.

CAD Station

1. Operate only with instructor's permission and after you have received instruction.
2. Reduce glare by tilting the screen 3 to 5 degrees.
3. Adjust keyboard and screen to comfortable height and position.
4. Prevent physical and emotional stress by taking a 15 minute break for each hour of CAD work. Radiation and contrast screens may be helpful as well.
5. Do not operate CAD without appropriate general illumination or in a darkened room.
6. Do not sit too close to the display terminal.

Foundry

Safe practices in foundry areas must be observed at all times. Mishandling of molten metal can cause serious burns that may result in permanent disability. Specific foundry operation may call for additional precautions, but in general the following should be noted:

1. When handling molten metal, wear proper protective clothing; safety glasses and face shield or helmet, apron, leggings and approved gloves. Tennis shoes or sandals are not acceptable.
2. Always treat crucibles, flasks, castings and other equipment as if they are hot; determine if they are hot before picking them up.
3. Ask your instructor to check your mold before closing it. Be sure that it is not too damp before pouring—it could explode as a result of rapid steam buildup.
4. Keep flammable materials away from the foundry area.
5. Light the furnace only when supervised by your instructor. Follow the manufacturer's directions and the posted procedure for lighting the furnace.
6. Before removing crucible, shut off the fuel first, then the air. Use a crucible lifter to remove crucible from furnace.
7. Carry molten metal as close to the floor as possible, and preferably using a two-person pouring shank.

8. Keep water and wet items away from the pouring area of the foundry. Moisture and molten metal can cause an explosion.
9. The foundry pouring area floor should be protected with sand to prevent accidental "floor explosions" caused by spills of molten metal.
10. In consumable pattern casting (styrofoam), keep the sprue basin filled to prevent firing; turn on foundry room area vent fan; do not breathe fumes.
11. In hot shell or CO_2 shell molding, the two halves of the mold should be securely fastened and banked in a flask of green sand to dissipate heat.

Electrical Safety

Ground fault protection

Ground fault protection is a recent development that can save lives. Ground Fault Circuit Interrupters (GFCI's) are now readily available which give sure protection against electrocution or serious shock from defective portable tools or cords. Their use should be encouraged in all areas, but particularly where there is a serious shock hazard from wet conditions.

Electrical component safety[1]

Many varied conditions can exist to create electrical safety hazards in tools, machines and components. Because of this, all ITE/TE facilities should incorporate a central power disconnect switch(s) or master shut-off switch. Additionally, instructors are well advised to regularly check for:

1. Insulation which is defective, inadequate, worn, frayed, wet, oily or deteriorated, creating short circuit possibilities and energizing equipment frames.
2. Defective switches, receptacles, extension cords and lamp sockets.
3. Dirty motor windings, improperly adjusted brushes and worn commutators.
4. Improperly connected power tools and defective insulation in portable tools.
5. Broken housings and loose or vibrating machine parts which might contact and energize tool or machine frames and expose "live" surfaces to operator.
6. Unsafe work practices. Unsafe practices and work procedures result in electrical accidents and fires. Examples of some common unsafe acts are:
    a. Using ungrounded equipment and portable tools (except double insulated tools) or removing ground connections.
    b. Using defective tools or equipment in need of repair.
    c. Using equipment which does not meet the Underwriters Laboratories standards for the intended use.
    d. Unsafe cleaning of electrical panels, switch boxes, motors and other electrical equipment with water or dangerous solvents.
    e. Overloading of circuits or overfusing circuits by the use of wrong size or type of fuse.
    f. Failure to use explosion-proof or other special wiring methods in hazardous locations.
    g. Failure to positively lock out or otherwise de-energize and tag equipment or circuits to be worked on. Do not rely on gloves, rubber mats, etc., for electrical installation and repair.
    h. Installation or extension of electrical facilities in a manner not meeting the National Electrical Code, e.g., electrical panels with 30" clearance.
    j. Using light duty, ungrounded extension cords for industrial educational service or in place of permanent wiring.

Traditional ITE Machines

A large variety of safety guidelines and materials exist for such equipment. Many of these are available from Missouri's MVRC. To avoid extensive duplicates, the development team compiled a representative list of sample machines and indexed the readily available safety materials. Figure IV-22 provides samples of machines, locations of safety handouts, and safety test. Instructors can secure these examples by requesting the appropriate document from MVRC by telephoning 1-800-392-7217.

Figure IV-22

Safety Materials Reference Table

Materials & Processes

Reference to...	Safety Handout (pgs)	Safety Test (pgs)
Equip. Safety Zones Specs.	A) H-1 - H-8	
Band Saw	A) R-19 C) 893-895 E) 288 H) 69	A) R-20 C) 897-898 E) 289 H) 70
Jointer	A) R-47 E) 308 H) 99 C) 1236-1239	A) R-48 E) 309 H) 100 C) 1241-1243
Scroll Saw	A) R-69 E) 332 C) 1276-1279	A) R-70 E) 333 C) 1281-1282
Router	A) R-15 D) 1365 E) 360	A) R-16 E) 361
Motorized Miter Box	A) R-55 E) 320 C) 1251-1253	A) R-56 E) 321 C) 1255-1256
Wood Shaper	A) R-83 E) 336	A) R-84 E) 337
Metal Lathe	A) R-49 E) 310	A) R-50 E) 311
Metals	B) 331-334	B) 335-338
Plastics	B) 363-370	B) 370-375
Electric Drill	D) 1362 E) 356	E) 357
Jig Saw	D) 1363 E) 352	E) 353
Portable Belt Sander	D) 1366 E) 362	E) 363
Table Saw	E) 292 C) 1212-1215	E) 293 C) 1217-1218
Radial Arm Saw	E) 328 C) 1269-1271	E) 329 C) 1273-1275
Drill Press	E) 296 C) 926-929	E) 297 C) 931-933
Belt/Disc Sander	C) 1226-1229	C) 1233-1235

Sources	MVRC	ITE
A) *Delaware Safety Manual For Vocational Education Programs.*	21.0101	A16
B) *Safety Education Handbook.*	21.0101 Vol. I	A16 a
C) *Safety Education Handbook.*	21.0101 Vol. II	A16 a
D) *Safety Education Handbook.*	21.0101 Vol. III	A16 a
E) *Health and Safety Resource Guide for Trades and Industry and Industrial Arts Programs in the Maryland Educational System.*	21.0101	A16f
F) *New Jersey Industrial Arts Education Safety Guide.*	21.0101	A16d
G) *Safety On The Job.*	21.0101	M281
H) *Pennsylvania Industrial Arts/Technology Education Safety Guide.*	21.0101	A16i

Energy & Power

Reference to...	Safety Handout (pgs)	Safety Test (pgs)
Lasers	H) 101	H) 102
Multimeter	C) 712	C) 713
Soldering Iron	H) 171	H) 172
Small Engines	B) 379	B) 380-381
Oscilloscope	C) 714	C) 715

Communications

Reference to...	Safety Handout (pgs)	Safety Test (pgs)
Screen Printing	C) 787	C) 791-792
Graphic Arts	B) 311-314	B) 315-320
Photography	B) 321-322	B) 323-328
Dark Room	C) 827-828	C) 841-843

General Safety

Reference to...	Safety Handout (pgs)	Safety Test (pgs)
Safety Posters	A) S-27	
Safety Inspection Check list	F) 200-210	
Fire Prevention	G) 8-33 - 8-42	G) 8-48 - 8-51
Hand Tools For Elem. Use	D) 1397-1416	
General Science Lab		B) 446-447
Special Needs Students	H) 26,27	
Permission Form	A) Q-2 H) 21	

Sources

A) *Delaware Safety Manual For Vocational Education Programs.*
MVRC ITE
21.0101 A16

B) *Safety Education Handbook.*
MVRC ITE
21.0101 A16 a
Vol. I

C) *Safety Education Handbook.*
MVRC ITE
21.0101 A16 a
Vol. II

D) *Safety Education Handbook.*
MVRC ITE
21.0101 A16 a
Vol. III

E) *Health and Safety Resource Guide for Trades and Industry and Industrial Arts Programs in the Maryland Educational System.*
MVRC ITE
21.0101 A16f

F) *New Jersey Industrial Arts Education Safety Guide.*
MVRC ITE
21.0101 A16d

G) *Safety On The Job.*
MVRC ITE
21.0101 M281

H) *Pennsylvania Industrial Arts/Technology Education Safety Guide.*
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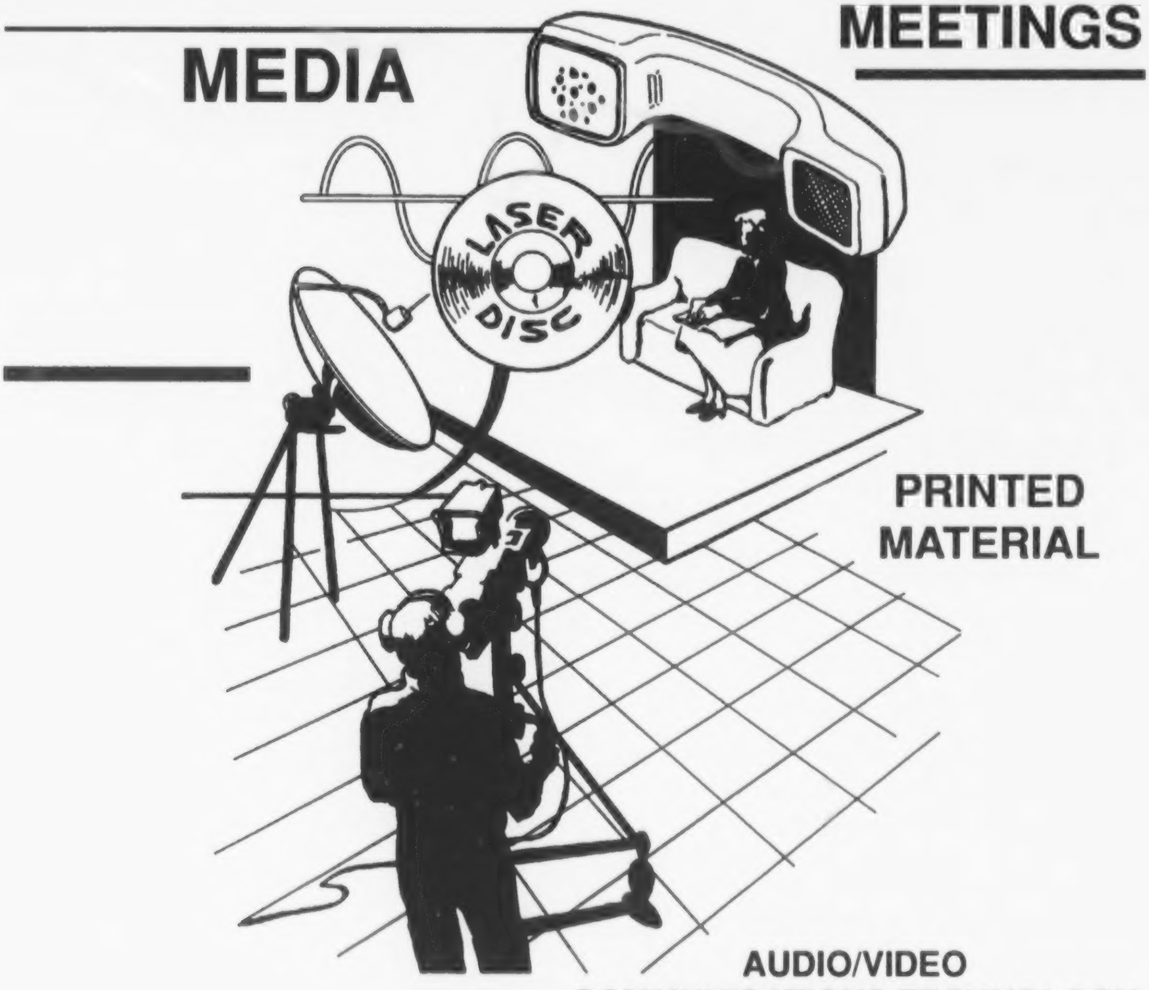
Chapter V

Creating ITE/TE's Image (Public Relations)


MEDIA
MEETINGS
LASER DISC
PRINTED MATERIAL
AUDIO/VIDEO COMMUNICATIONS TECHNOLOGY

PUBLIC RELATIONS FOR ITE/TE

Chapter V

Creating ITE/TE's Image (Public Relations)

1. Introduction & Overview

Successful teachers and administrators frequently inform key constituencies in order to promote a more positive image of ITE/TE (public relations). Effective public relations begins with systematic analysis and planning as outlined in section 2 of this chapter. Comprehensive plans include PR activities that use school-focused events, various media and meetings to communicate the ITE/TE program's message. These approaches are highlighted in sections 3, 4 and 5. Finally section 6 lists some resources that will be helpful to those wishing more information.

Objectives

This chapter provides direct guidelines to help industrial technology/technology educators envision, develop and conduct public relations activities that:

- Explain the program to parents, influential citizens, significant others, and key decision makers.
- Focus positive attention on the good things happening to students in your school.
- Bring your program to the students' attention—even those not currently enrolled.
- Make it easier to secure basic and/or supplementary support and even overcome any problems that might arise.
- Empower teachers to better engage in public relations activities.

Chapter V Outline

1. **Introduction & Overview** 1
2. **The PR Planning & Implementation Process** 1
3. **School-based PR Program Elements** 8
4. **Media-based PR Program Elements** 19
5. **Meeting-based PR Program Elements** 31
6. **Resources** 39

2. The PR Planning & Implementation Process

Technology education in the spotlight states, "Technology education has a great deal to offer students to help prepare them for life in a high-tech 21st century world. But the image of technology programs does not reflect the worth and excitement of the discipline. ... You can change that image." (p. 4) A comprehensive public relations program begins with a systematic plan. ITE/TE instructors are encouraged to employ the following steps (adapted from *Promoting vocational education,* p. 13) in developing their public relations program:

Figure V-1

ITE PR Planning Work Sheet

1. Specify the gist of the message you want conveyed: ______________________
____
____
____
____

e.g., ITE is exciting, fun and you should enroll.

2. From the list of potential audiences at the right, select one you most want to impact with the above message.

Target Audience: ______________________

e.g., 9th grade students

Describe relevant audience characteristics: ______________________
____

e.g., those 9th graders, passing into 10th grade, at the time they are making out their next year's schedule

3. From the list of potential vehicles at the right, select the one that seems most feasible in terms of cost, effort and impact.

Potential Vehicle: ______________________
____

e.g., a poster showing similar students having "fun" in a lab filled with neat, "high tech" equipment. Poster tells "next steps" students will need to do to enroll.

Potential Audiences

- Parents
- Students not in ITE
- Students in ITE
- Business & industry personnel
- Principals
- School board members
- Other teachers
- …

Potential Vehicles

- Brochures
- TV show
- Radio program
- Service activity
- Posters
- Displays
- Contests
- Open houses
- …

Potential Messages

- ITE is fun
- ITE is useful for future work
- ITE is important
- ITE reinforces academics
- ITE is interdisciplinary
- Smart, college-bound students take and benefit from ITE
- …

4. Prepare the PR product/activity

1. **Identify your internal and external publics.** Think in terms of the influential individuals and groups in your community such as those named in Figure V-1 and V-3's first columns. Also, *Technology education in the spotlight*, (p. 7-9), provides an excellent overview of these various publics.
2. **Collect data on your publics.** Find out what your publics know and think about your programs, and what they want and need to know. Do your homework carefully—there is no point in spending time and energy to launch a public relations campaign without first knowing what change you should try to bring about.
3. **Identify the problem areas.** As you assess the views of your publics, certain problems and issues will begin to emerge. It is important to develop an overview of audiences, messages and possible public relations vehicles in terms of the products to be planned.
4. **Check your local board of education's and school's policies** and regulations for guidelines that apply to public relations activities. They may also employ people or agencies who can give good advice.
5. **Establish short- and long-term objectives for your public relations thrust**. Be realistic about what can be accomplished. Note that this involves prioritization of audiences, messages and vehicles. Figure V-1 can help you identify these priorities by placing them all before you. You may wish to highlight the most important cells to serve as a reminder and planning guide for subsequent steps.
6. **Determine your public relations details, organization and strategy for each objective established in step 5** (above). Select the communication techniques and media for accomplishing each above objective. This step focuses on answering the question, "What is the most effective method of getting your message across?" It involves thinking simultaneously about the message to be communicated and the characteristics and purposes of the various techniques/media. You will also have to consider your budget in making plans, but don't feel that the job is hopeless if your budget is small or nonexistent. Ask for volunteer help and keep an eye out for shortcuts and low-cost techniques.

   One prime source for such help is MOVEMCO. The Missouri Vocational Education Marketing Committee (MOVEMCO) was established in 1988 by the Missouri Department of Elementary and Secondary Education. Its purpose is to plan, design and implement a comprehensive marketing/public relations program for Missouri vocational education. The statewide committee includes representatives of school districts, area vocational schools and community colleges, vocational administrators, school public relations specialists, and state education officials. The committee's mission is to strengthen the Missouri system of vocational education through increased public awareness of opportunities in vocational education, increased enrollment in vocational programs, a more positive public perception of vocational education, and increased funding for vocational education. For more information, contact the Coordinator of Vocational Education, Department of Elementary and Secondary Education, P.O. Box 480, Jefferson City, MO 65102-0480 (314/751-3500).

Figure V-2

Sample Annual Calendar for Public Relations[1]

Month	Target Group & Event	Public Relations Activity
September	Back to School Night Parent Teacher Organization mtg	ITE/TE Program display in school foyer Presentation to PTO about ITE/TE program
October	Guidance Counselors Conference	MITEA presentation about new ITE/TE program
November	MITEA Fall Conference Teachers Convention	TSA Chapter participation Local newspaper article about professional development activity by ITE/TE teachers
December	Technology Education Division of the AVA National Conference School Holiday Assembly	MITEA Newsletter article about conference impressions and the profession's progress One minute "commercial" about ITE/TE program with students doing the assembly's recording & audio needs Student/TSA charity toy production project
January	School Career Day	ITE/TE teacher education program participation in teaching as a career Showing of *A career in teaching ITE* video tape ITE/TE advisory council meeting and report
February	National Technological Literacy Conference, National Association for Science, Technology, Society State History Week	Joint learning project (e.g., ecology) with science and social studies teachers and students in identifying problems in town and envisioning and prototyping solutions School display of history of local industry and new technological trends that affect it
March	MITEA Spring Conference International Technology Education Association National Conference	TSA chapter participation in both state and national conferences Open house and newspaper article about participation Letter and report to school board
April	Missouri State Contest & Technology Exposition; National Science & Technology Week	Student participation in contest and Expo. News release about results to newspapers School Technology Fair/Festival
May	Next year registration	Displays, presentations to classes, distribute literature to guidance counselors
June	TSA National Conference Awards Day	Participate in TSA events Recognition for individual and program successes. Outstanding inventor , advisory council service...
July	Technology facility renovation MVA conference	Progress report to local newspapers and school administration Share description of PR success
August	Pre-School start professional development workshops	Newspaper article about teachers implementing state goals for education and school improvement. Success story of recent graduates

---

[1] Adapted from *Technology education in the spotlight*, 1990, p. 5.

Some items to consider in a plan include those listed below. Further details are provided in the sections following the pages shown below.

- School-based public relations 8
- Media-based public relations 20
- Meeting-based public relations 31

Additional vehicles and activities might include:

- A program advisory council
- Buttons
- Cable television shows, public access channel
- Locally developed videos
- Utilization of available videos (e.g., PITSCO, ITEA…)
- Community "open laboratory" nights
- Computer bulletin board
- Develop and distribute an annual report
- Develop contacts with local technical groups, guest speakers
- Field trips
- Get industry to sponsor a billboard
- Interface to the PTO (e.g., letter presentation outline)
- Local, state & national competitions, (e.g., TSA, MO's ITE/TE Awards)
- Newspaper articles
- Organize and/or participate in a speaker's bureau
- Establish promotional committee in student organization
- Posters/Bulletin boards
- School, program or TSA chapter newsletter
- Slide shows
- Student organization activity, e.g., service activities, TSA affiliation, …
- Student-made "giveaways"
- Technology festival

7. **Map out your program**. Schedule your activities in chart or calendar form. Time activities so you reach your publics frequently. This latter point is particularly important. Many frequent contacts and exposures are more effective than even one spectacular event. Furthermore, developing a year-long public relations calendar helps encourage your own regular attention to public relations. Additionally it positions you to take advantage of other school, local, state and federal activities. Examples of such possibilities include the school's anniversary, a local promotion such as "Spring Fling," state conferences and workshops, and National Science and Technology Week. Advance notice and preparation helps make recruiting volunteers and support easier as well. A sample of an overall PR calendar is provided in Figure V-2.

8. **Implement your program**. This is the most time-consuming and difficult part of the process! Monitor your expenses in time and money as you go along, and reallocate your resources as necessary.

9. **Evaluate your program**. At least once a year, study the effectiveness of your efforts. Figure V-3's matrix provides a framework useful for such an assessment. Use your findings to make adjustments in future planning. Topic 8 of the MO ITE/TE Standards, provided in Figure V-4, can be used to assess public relations activities in greater detail.

Figure V-3

Public Relations Analysis Matrix

Target Groups (Audiences)	Objectives & Activities	Achievement Review						
		EVALUATION						COMMENTS
		Difficulty			Achievement			
List each specific target group important to your program's public relations	List specific objectives for each target group. Specify date and out-come measures.	Difficult	Average	Easy	Completely	Partially	No Progress	Update objectives and activities here
Internal Administrative Staff Advisory Committees Federal/State ED. Agencies Guidance Personnel Other Teachers School Board Members Students (current & potential) Student Organizations Support Staff **External** Business & Trade Groups Business/Industry People Civic & Service Groups General Public Employers Legislators Labor Organizations Mass Media Parents Colleges Other:________________								

INSTRUCTIONS:

Enter the objectives and dates for each specific target group. Also rate the difficulty of each objective/group combination. Then, at the end of the year, rate the extent to which you have achieves each objective. At that time also develop a new plan for the following year. Adapted from *Promoting vocational education...*, p. 17).

Figure V-4

MOITE Standards, Topic 8: Public Relations

Industrial technology education is comprehensive, ever changing, and complex. The public relations task of the teacher will be a constant challenge. As a critical component of lifelong learning, industrial technology/technology education must be understood and accepted by the general public and key decision makers. The statements contained within this standard topic concern public relations. An informed and involved public is essential to the promotion of an industrial technology/technology education program. Various media are utilized to inform target populations.

Fill in marks to indicate assessment: ∇ **not met,** 0 **met,** Δ **exceeded**

1. Students promote and support technology education/industrial technology programs through involvement in activities, including TSA or local program student clubs. .... ∇ 0 Δ
2. Parents are allowed to support and participate in the technology education/industrial technology program by functioning as paraprofessionals, advisors, or resource people. .... ∇ 0 Δ
3. Non-technology education faculty and staff are informed about the technology education/industrial technology program for the purpose of generating support, guidance, and interdisciplinary education opportunities. .... ∇ 0 Δ
4. Building and district administrators are informed about and participate in the technology education/industrial technology program. .... ∇ 0 Δ
5. Individuals and organizations outside the school community are informed of and encouraged to support and participate in the technology education/industrial technology program. .... ∇ 0 Δ
6. A public information program is utilized to inform and encourage the support of local elected and appointed officials, including school board members. .... ∇ 0 Δ
7. Local radio and television, as available, are utilized to promote the technology education/industrial technology program activities and accomplishments. .... ∇ 0 Δ
8. Articles describing unique activities and accomplishments of the technology education/industrial technology program are prepared and published in the local news media, as necessary. .... ∇ 0 Δ
9. Printed material (handbooks and brochures) describing the technology education/industrial technology program, goals, objectives, and policies are prepared and utilized. .... ∇ 0 Δ
10. Articles describing technology education/industrial technology program activities and accomplishments are prepared and published in local, state, and national professional publications. .... ∇ 0 Δ
11. Media events, including open houses, exhibits, displays, presentations, demonstrations, and technology education/industrial technology week activities are utilized to promote the program. .... ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): — — —

3. School-based PR Program Elements

Personal & Program Professionalism

Each ITE/TE instructor should be certain that his/her appearance, attitudes and performance are a powerful determinant of the program's image (PR). Also central to a program's image is what it does for students and the appearance of the facility it operates within. Housekeeping, cleanliness, aesthetics and instructor attire are all important factors that contribute to the image. Curriculum activities that reflect modern technology are absolutely essential to effective public relations.

Technology education in the spotlight (p. 12) lists the following as key factors in shaping the image of ITE/TE:

- Appearance
- Speaking and writing exposure
- Professional roles such as school and community committee participation
- Team/collaborative teaching
- Social participation
- Sponsoring clubs and/or student organizations such as TSA

Each ITE/TE instructor should be certain that his/her appearance, attitudes and performance are a powerful determinant of the program's image (PR). Also central to a program's image is what it does for students and the appearance of the facility it operates within.

Letters

Letters can frequently serve as a very useful PR tool. This is particularly the case when they are directly addressed to someone influential. This guide presents three such samples. One is a letter to a newly installed PTA president (Figure V-5), and the second (Figure V-6) and third (Figure V-7) are samples prepared for various editors of various publications that may be interested in printing articles about local technology programs.

An interesting opportunity for exposure is provided by newspaper and journal "letters to the editor" sections. Remember that short, clear letters are more likely to be published. Also, positive and well-reasoned pieces secure more favorable attention than negative ones.

Themes

Public relations is most effective when it results in readily identifiable positive images for a program. Often slogans make public relations memorable and especially effective. All of a program's public relations efforts should feature the selected slogan. Examples of possible slogans are:

Plug into the world of today and tomorrow
Touch the technology of tomorrow in class today
Hands-on the tools of tomorrow in class today
Putting the future in students' hands today
Technology: The key to tomorrow's world and today's
Guiding students to technological competence
Part of a proud tradition
Content that is today and tomorrow
Technology education: The new basic
Technology education: Delivering the future today

• • •

Figure V-5

Sample Letter to PTO President[1]

Progressive City Schools
Anytown, MO 60000

Date

Addressee
~~~~~~~~~~~~~~~
~~~~~~~~~~~~~~~
~~~~~~~~~~~~~~~

Dear ~~~~~:

Please accept my best wishes as you begin your presidency of our school Parent-Teacher Organization. I know the year ahead will be both challenging and rewarding.

As you know, our technology department is excited about this school year. We are presenting a new and stimulating technology curriculum to our students. I have attached a letter and a brochure that are being sent to all parents. The letter gives a basic idea of our goals and aspirations for this new school subject. I am sure you will find it both interesting and enlightening.

While the letter and accompanying brochure are informative, they do not have the impact of a personal presentation. I would like to suggest that, as you prepare your meeting schedule for the coming year, you may wish to find an opportune time to schedule our department on your agenda. We would appreciate the opportunity to speak to parents regarding the new program and how it will impact our children. I am sure the parents will be interested to learn about the new curriculum. A suggested presentation outline is enclosed for your review.

We would appreciate your consideration of this request. I am looking forward to hearing from you at your earliest convenience.

Sincerely,

Teacher or Chairperson, Department of Technology Education

Encls: Letter to Parents
Brochure
Presentation Outline

---

[1] Adapted from *Technology education public information handbook*, NYS, p. 8.
~~~~~~~~~~~~~~~

Figure V-6

Sample Letter to an Editor[1]

Progressive Schools

Progressive City Schools
Anytown, MO 60000

Date

Addressee
~~~~~~~~~~~~~~~
~~~~~~~~~~~~~~~
~~~~~~~~~~~~~~~

To the Editor:

The technological age in which we live demands a more highly educated populace and work force. More than ever before, people need to be able to understand the technical complexities which pervade virtually every aspect of our culture.

Technological literacy is a new basic for citizens living and working in the 21st Century. For Missouri to remain competitive in a global economy, our citizens must acquire new levels of technological capability.

(NAME OF SCHOOL OR DISTRICT) has implemented a new curriculum, industrial technology/technology education, which will provide students in grades 7-12 with the means to solve technological problems through exciting hands-on, laboratory-based activities.

The industrial technology/technology education program is a positive step in helping business and industry in Missouri regain the essential ability to generate technological innovations. Through this new program, students will be introduced to a variety of promising career opportunities, and will be provided with a base of transferable skills necessary for successful career mobility and competitiveness, as well as for effective citizenship.

I urge all parents in our district to familiarize themselves with the opportunities this new course of study offers their children, and to encourage their children to take full advantage of the many benefits industrial technology/technology education affords.

Sincerely,

Teacher or Chairperson, Department of Technology Education or Principal

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[1] Adapted from *Technology education public information handbook*, NYS, p. 14.
~~~~~~~~~~~~~~~

Figure V-7

Sample Letter to Education and Business Editors[1]

Progressive Schools

Progressive City Schools
Anytown, MO 60000

Date

Newspapers—Dailies and Weeklies
Television and Radio News departments
Appropriate newsletters (i.e., Chamber of Commerce, business publications - address each editor by name)

Dear Mr. Jones:

The Missouri Department of Elementary and Secondary Education has developed a new and exciting curriculum, which is now being taught at (NAME OF SCHOOL). This curriculum was developed with the assistance of literally hundreds of technology teachers, scientists, engineers, business leaders, school board members and school administrators.

Industrial technology/technology education will provide students at (NAME OF SCHOOL) with (NUMBER) courses that will inculcate broad-based transferable skills and problem-solving techniques to provide higher levels of technological capability.

At the middle/junior high school level, the program introduces students to technological processes, the resources required by technological systems and the impact of these systems on society. High school courses will focus on materials & processes, energy & power and communication systems. They also provide a foundation in the areas of energy, electronics and technical drawing. The courses are all taught through hands-on learning activities in laboratory settings.

This new basic will give the students at (NAME OF SCHOOL) a head start in gaining the technological literacy necessary to succeed in the technical professions of the future. It will provide a competitive edge for those students who intend to pursue courses in higher learning in institutions which offer degrees in the fields of science and technology.

We in the teaching profession are very proud of this new school discipline. I have enclosed a brochure and fact sheet which describe our program in greater detail, with the hope that you will consider a feature article on the subject. Your contact within the district is (NAME OF APPROPRIATE CONTACT PERSON), who will be happy to work with your reporters.

We look forward to working with you on this feature.

Sincerely,

Teacher or Chairperson, Department of Technology Education or Administrator

encl: brochure

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[1] Adapted from *Technology education public information handbook*, NYS, p. 13.

Brochures and Printed Materials

Because of their size, convenience and low cost, brochures and printed materials, e.g., an annual report, are favorite public relations strategies. Quality in design, paper and printing are essential for best impact. New Mexico's Council on Vocational Education's *PR guide…* (1988) provides some very useful insight to help teachers prepare such materials. It states:

> "Unfortunately, many of the messages sent out by school personnel leaders are like messages put in a bottle and tossed in the sea. For one reason or another, sluggish language, dull content, too much information or poor distribution cause the message to get lost, causing people to neglect to read the material. Take a simple test. You undoubtedly receive a lot of printed material of one kind or another.
>
> - How much of it do you read?
> - Why do you read some and not others?
> - A quick tour of the wastebasket should be revealing:
>   - What did the discarded newsletters do to turn you off?
>   - They were probably too complex, too abstract, too long, not relative to your interest or just downright dull. (p. 1)"

Bochure Hints

- **Terse Wording**
- **Quality pictures**
- **Simple, eye-catching cover**
- **Use of color**

Printed product ideas include fact sheets (Figure V-8), posters, program brochures, annual reports, placemats, calendars, notepads, stationery, business cards, flyers, program handbooks, and newsletters. Only imagination, and in some cases, costs, restrict the possibilities.

There are several important facts to keep in mind when compiling a brochure[1]:

- Organize your material.
- Keep your copy brief and to the point.
- Use pictures only when you can get quality printing.
- Don't put more than one idea on the cover.
- Don't clutter the cover with words, illustrations or other graphics—try to convey one idea as simply as possible. Sometimes one illustration is effective—or one word—or just a sentence.
- Use color if at all possible. Make brochures eye-catching.
- Consider incorporating a reader-reaction form.

In Missouri, copies of a 12-page brochure and a poster promoting ITE/TE are available through the Missouri State Supervisor of ITE and/or the Instructional Materials Laboratory (IML). Also available is a 1 page brochure that is designed for local reproduction and that includes space for local tailoring of its content.

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[1] Adapted from *Promoting vocational education*, WV, p. 15.

Figure V-8

Sample Technology Education Factsheet [1]

Technology Education Facts

In the United States, eight percent of the college graduates receive degrees in science and engineering. In Japan, 40 percent receive science and engineering degrees. Forty percent of U.S. patents are awarded to foreign nationals.

Presently, America produces only a few televisions & VCRs, and those contain many imported components. Most of the cameras, stereos, tape recorders and calculators used here are imported. Japan has taken over world leadership in semiconductors. Seventy-five percent of all the bearings used in the United States are imported, as are 90 percent of the power shovels used in mining industries. The President's Commission on Excellence in Education declared, "America is losing its preeminence in technological innovation."

A new school subject, industrial technology/technology education, has been introduced into Missouri's schools to provide students with technological literacy as a part of their fundamental education. The program is taught by fully certified industrial technology/technology education teachers. The ITE/TE program is based upon a systems approach. It stresses applying technological knowledge to the solution of real-world problems.

> **America is losing its preeminence in technological innovation.**

Middle school's Introduction to Technology program will include experiences and activities involving materials & processing technology, communication technology, and energy & power technology. Even biotechnical systems can be addressed. The Introduction to Technology program is taught through a laboratory-based, design-and-construct approach, involving the use of technological equipment and materials.

High school technology courses focusing on each of the technical systems that were introduced in the middle schools are also offered. Subsequent pre-technical/ tech-prep courses can include: Technical Drawing, Architectural Drawing, Graphic Communications, Industrial Electronics, Manufacturing, Production, Instrumentation Technology, and Research & Development.

Industrial technology/technology education helps students discover their interests and talents in technological areas and explore their potential for careers in the technical professions. Technology Education is an integrating discipline. The subject serves to provide and reinforce genuine interdisciplinary connections to other school subjects (such as mathematics, science, language arts and social studies), and real-life experience. More than two thirds of America's states and many foreign countries have implemented Technology Education programs.

> **Technology Education builds the skills America needs.**

---

[1] Adapted from *Technology education public information handbook*, NYS, p. 2-3.

Checklist for Printed Items

Given imagination, a computer, a reasonable printer and access to a commercial copy service, if not to a school graphics facility, teachers and students can produce very useable items most cost effectively. The following checklist (Figure V-9), adapted from *Technology education in the spotlight*, p. 16, will help assure quality:

Figure V-9

Printed Product Checklist

☐ Get the most important information where it is read first.
☐ Appeal to the reader's ego or self-interests.
☐ Use simple words—remember, you are not writing a thesis.
☐ Avoid trite phrases. Write as originally as possible.
☐ Use statistics if you can.
☐ Break up the copy with subtitles.
☐ Use action verbs in headlines.
☐ Use the appropriate type style. (An example of an inappropriate typestyle is Old English, which does not suggest current high technology. Look at publications which have the tone you would like to convey for examples of effective combinations of typefaces.)
☐ Size type appropriately for emphasis and readability (No type should be smaller than 10 point and that should be used sparingly.) Varying type sizes are usually more pleasing than sole use of a single size.
☐ Feed information in small bites. Use an uncrowded layout with reasonable margins and space to separate messages.
☐ Where space is tight, differentiate message using heavier or larger type, box outlines, italics, or superimposed tinted areas.
☐ Use color judiciously for emphasis and organization.
☐ Align type properly.
☐ Use pictures to augment text.
☐ Use a paper and a format that enhance the message.

Photography Hints[1]

Check with editors about any photograph requirements they may have. They vary greatly between media sources, depending upon the make-up and budget of the media. Some newspapers and magazines will send out a photographer to cover a story if they are informed of it in advance. If you send photographs with a release story, follow the editor's directions for picture size, arrangement, type of paper, finish, etc. Most newspaper editors will accept only black and white photographs. Be sure that any picture you send in is clear and sharp. Make sure that the photograph you send in is an action photo. People doing something is a lot more interesting than people doing nothing. Crop pictures to focus on only the primary interest.

Always use captions to explain pictures. When sending photographs, be sure that you accurately identify everyone in the picture. Give an explanation of what is being done in the picture. DO NOT do this in pen or pencil on the back of the photograph. Type the necessary information on a plain white sheet of paper and attach it with rubber cement to the bottom and back of the picture with the typing and picture facing up so the editor can easily read it. DO NOT paperclip or staple this information to the photograph.

A good idea for a guest speaker at one of your chapter meetings would be a professional news photographer. You can learn much from him/her about photography, and at the same time, inform him/her a little more about TSA. Both of you would benefit from such an engagement. The New Mexico *PR Guide* (p. 12) contains the following photographic suggestions:

- Get in close to your subject
- Avoid large, distracting foregrounds
- Avoid group pictures with more than five people
- Avoid lining up people just to take their pictures. It would be better to have them doing something
- Be certain to have enough light and use a fill flash
- Study good photographs to learn key characteristics
- Avoid using snapshot cameras unless they are all that are available
- Take only black and white pictures for newspapers

National Science & Technology Week[2]

The observance of a national professional week has potential for significant impact when the profession promotes its concepts and activities. Below are suggested activities that teachers and students should consider in publicizing industrial technology/technology education activities and programs. Supplement these with ideas and innovations suitable for your local school community, **such as cooperating with your science teachers**.

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[1] Adapted from *TSA chapter handbook.*

[2] Adapted from *A handbook for public relations programs*, 1982, p. 41-42.

School activities

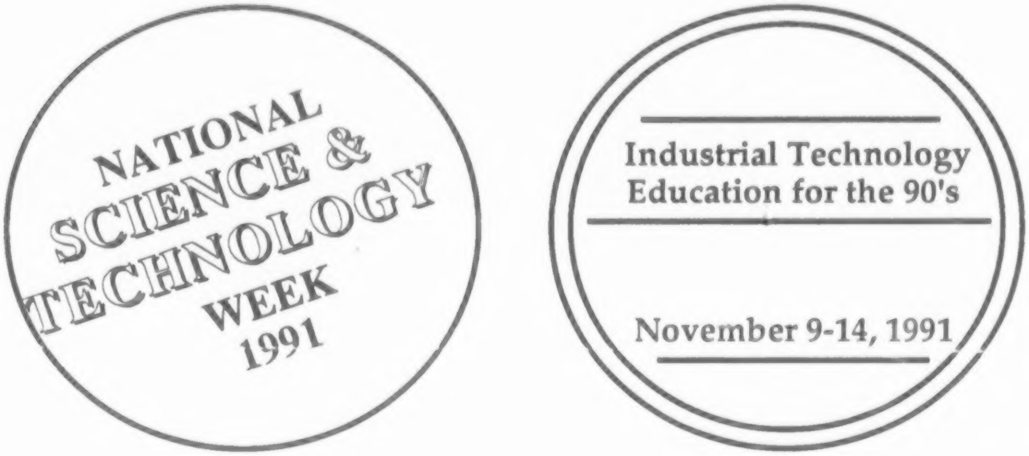
- Promote ITE/TE student visibility, e.g., TSA activities, t-shirts, buttons, blazers, posters, and banners.
- In-school open house: During school hours for faculty, administration, and students.
- Career orientation program: Involve representatives from business and industry for the entire school. Sponsor by industrial technology/technology education department.
- Information-sharing seminar between industrial technology department and guidance departments. Stress career exploration in technology.
- Service activities: Donate faculty and student time toward a worthwhile school goal or service project such as "Toys for Tots" or senior citizen home and/or car maintenance.
- Student recognition program publicly honoring achievement of outstanding students.
- Enlist support of school administrator in publicizing and otherwise recognizing special ITE/TE events, activities, and accomplishments.
- Information-sharing seminar with teachers, counselors, administrators, and supervisors, including academic and vocational education students.
- Encourage tech-prep dialogue with community/junior colleges and vocational-technical training institutions, both public and private, related to continuing educational opportunities for industrial technology/technology education students.
- Hold "Alumni Day" inviting ITE/TE graduates and employers to tell of benefits of ITE/TE in order to assist students in making meaningful career choices.
- Invite participation of local Chamber of Commerce, service organizations, social and recreational groups in school activities promoting ITE/TE.
- Recruit volunteers to provide interesting and informative programs at service organization meetings related to contributions and benefits of ITE/TE.
- Conduct poster contest for National Science & Technology Week. Figure V-11 shows an example poster.
- Distribute buttons announcing National Science & Technology Week (NASTW), as shown in Figure V-10.
- Bulletin board displays.

Community activities

- Student visibility. Posters, letter to parents.
- Program displays. Shopping malls, store windows, supermarkets.
- Open house and evening programs—could coincide with in-school open house. Invite community, especially business and industry. Mayor's proclamation. Public pronouncement by local official of service project. Donation of faculty and student time to a worthy community service project.
- Community survey of interests and needs of students and parents to call attention to the industrial technology/technology education program.

Figure V-10

Sample ITE/TE Promotional Buttons



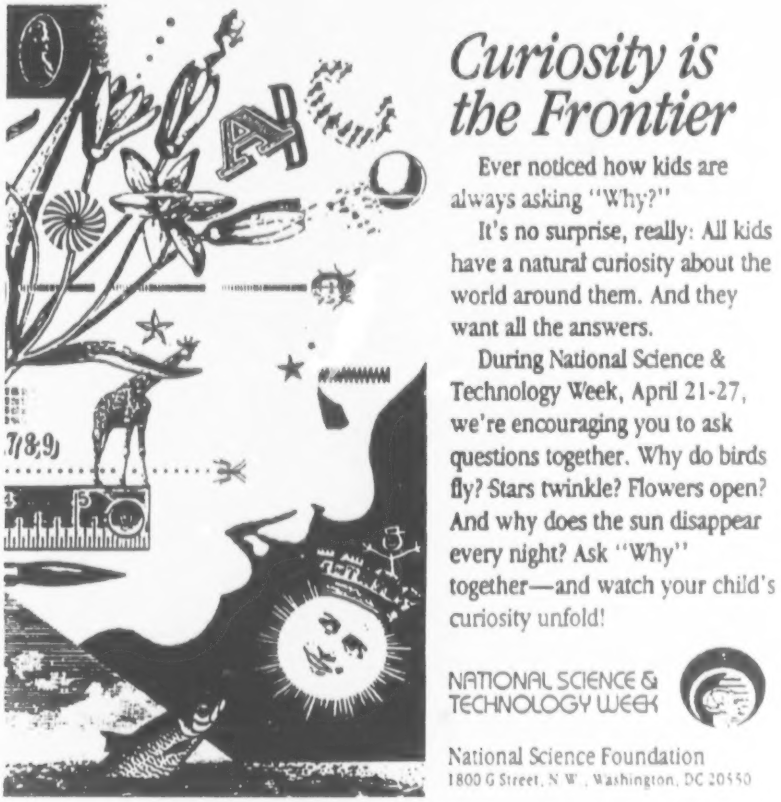
- Enlist support of local business and industry to provide field trips and other career orientation activities. Could be done in conjunction with in-school career day. Stress occupational awareness.
- Establish a "summer job co-op" program to find jobs for students and provide a source of qualified temporary help for local business. Stress vocational guidance.

Media (To advertise above activities)

- News articles. Try the Business Section of the Sunday edition in the (often better coverage than a daily issue). Include photos of good quality.
- Radio/TV. Local interest program (talk shows)—usually more profitable than news. Spot announcements work well for specific events but are generally **not** effective for publicizing overall program.
- Suggestions:
  a. Include as many people as possible. The media likes to use names.
  b. Provide high-quality visuals—one picture is worth . . .
  c. Tie in school activities with local business and industry.
  d. Tell of successes. Show new activities, let the students do the bragging, cooperative programs, special events, or projects.
  e. Include community-wide activities (better chance of getting air time). Let a local public official do your talking through proclamations, etc.
- Project Fair—at local shopping center.
- Announce NASTW on grocery store bags, placemats or banners.
- Bumper stickers.
- Dissemination of TV/radio promotional materials.

Figure V-11

Sample National Science and Technology Week Graphic



Curiosity is the Frontier

Ever noticed how kids are always asking "Why?"

It's no surprise, really: All kids have a natural curiosity about the world around them. And they want all the answers.

During National Science & Technology Week, April 21-27, we're encouraging you to ask questions together. Why do birds fly? Stars twinkle? Flowers open? And why does the sun disappear every night? Ask "Why" together—and watch your child's curiosity unfold!

NATIONAL SCIENCE &
TECHNOLOGY WEEK

National Science Foundation
1800 G Street, N.W., Washington, DC 20550

4. Media-based PR Program Elements

Media Contact Suggestions[1]

It is important to recognize that the media are always seeking good news stories and feature ideas and will welcome your suggestions, even if they cannot accommodate all of them.

1. Invite a local media representative to speak to your class or group or to meet individually with a technology education and TSA representative.
2. Create a media list. Call each newspaper (including the school newspaper) and radio and television station in your region to secure names of assignment editors (print media), news directors (broadcast media), and education reporters. Do not forget newsletters produced by businesses and other organizations in your area. Also be sure to contact weekly newspapers and pennysavers. Compile a mailing list of press contacts. (If at all possible, enter them into a computerized database.) Then print out labels which can be used for your next mailing (this might be the focus of a class project).
3. The editorial box of each newspaper is found within the first four pages of the paper and/or on the editorial page. It contains all of the pertinent information about the editor, the publisher and the newspaper itself. A call to the 'newspapers' offices will provide you with any additional information needed (i.e., names of business, education and feature reporters, etc.).
4. Send a fact sheet and press release, along with a contact name, phone number and your intent to make a follow-up call, to the media representatives.
5. Make follow-up calls one week after the press mailing. Offer to arrange an interview with a Technology Education representative (possibly yourself). The interview may be for radio, television or print. Offer a tour of the teaching facilities while an exciting and highly visual project is taking place. This will provide an opportunity for photographs to accompany the story.
6. Your contacts with the media should be an ongoing process. Keep the media informed of any new happenings in the field, class projects, etc., which might make an interesting feature.
7. Please share samples of your release or other correspondence with the media and copies of articles placed in your local press with the Missouri State Supervisor of Industrial Technology Education and with the MITEA newsletter editor so that your counterparts can benefit from your successful efforts.

What do the Newspapers Want?

First: They want human interest stories of all kinds, not just the big tearjerkers.

Second: They want steady, day-by-day, year-round coverage. This is much more effective than big splurges periodically. Artificial publicity is damaging to good public relations with your own co-workers and others with whom you must work.

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[1] Adapted from *Technology education public information handbook*, NYS, p. 17.

Third: They want easy-to-understand interpretations of your program and services, simply told and full of human interest. There should not only be a build-up of one individual, but many folks and many situations.

Look for material that would make good public relations stories—it is all around you. The school and community program is full of good stories waiting to be told. Examine your job, your students, your classroom with a magnifying glass.

Dramatize your story, preferably through real-life situations involving vocational students and parents, or co-workers. To gain a point, use people, fictitious or real, rather than theories. You can spot many of these and more 'under your nose', for example:

- Contests: Announcements of rules, announcement of programs, announcement of winners, human interest stories about contestants.
- Club Meetings: Stories about the club, announcement of coming club projects, meetings, club program for the year, the officers of the club, speakers at club meetings, announcement of committees.
- School Program: Aims of the program, interview by students of community leaders, special events—career days, trips of interest, success stories of students or workers, etc., special program (TV or radio), displays, exhibits.

Preparing News Articles[1]

What's your batting average with the newspapers? Have you had trouble getting materials into print? Here are a few simple rules to follow to make your life easier and your newspaper happier. Remember, no one can tell you how to write a news article. You must find out through reading and practicing and then repeating the reading/practicing process until you have attained the skill.

1. Articles should be typed, double spaced, on 8-1/2 x 11 inch paper, and limited to one page, if possible.
2. Your name, organization, and other identifying information should be at the top of the paper.
3. Have a LEAD LINE—Start the article with WHO? WHAT? WHERE? WHY? HOW? Put the least important facts at the end.
4. Use short, concise sentences. Don't put the verb several paragraphs away from the subject. Use 5¢ words--save the 25¢ words for your thesis.
5. DON'T write headlines. The editor has an expert for this.
6. If you have a long story (2-3 pages), be sure to write the word "more" at the bottom of each page. Leave enough space at the top for the newspaper person to write any special directions or notations for the paper.

Radio and Television Publicity Tips[2]

Although radio and television exposure may seem to be expensive for public institutions, there is no need for great expense. Each year, millions of dollars worth of air time is designated by the broadcast industry as public service time (time that organizations serving the public can use without charge). Radio and television stations are required by law to run a certain percentage of public service announcements. School and TSA activities have a broad enough appeal so as to warrant a share of this time. You and/or your students may develop public service announcements and get some air time. This is particularly true in smaller, less crowded markets.

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[1] Adapted from *Promoting vocational education*, WV, p. 3-4.

[2] Adapted from *TSA chapter handbook.*

Radio spots are community announcements or commercial messages. They usually are 30-second announcements; however, some do run shorter or longer. Their messages carry information to the public as a service. For visual media, augment your message with logos and photogenic images. For audio messages, provide similar insights orally. When you write releases for radio, do so in the same manner you would for newspaper copy. Be brief, concise and neat. Submit the radio release on 8 1/2" x 11" plain white paper, typed double-spaced. You may want to submit your release in varying time segments, such as 10-second, 30-second, and 60-second segments. Again, as with the newspapers, check with the local station manager to see if there are any special requirements. He/she may have some interesting ideas for your chapter.

Television spots require more effort and planning than do radio announcements. Television as a media provides a visual as well as a spoken message. Plan all television spots carefully. Check with the appropriate station manager as to requirements, ideas, and possible formats that you could use. You may desire to seek the services of someone who has been involved in the broadcasting industry. Here again is a good idea for a guest speaker.

Industrial technology/technology education school and TSA activities warrant a share of public service time.

Type out the message you wish to send and check its length against these recommended word counts[1]:

Television	Radio	Time for Announcement
12	25	10 seconds
35	50	20 seconds
120	150	60 seconds

Additional public service announcement details, insights and suggestions may be found in *Technology education in the spotlight*, p. 22-24 and in New Mexico's *PR Guide* (1988), p. 10. Essentially they recommend:

- Developing a statement of purpose before requesting media coverage.
- Getting school decision-maker approval of the message to be communicated.

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[1] From *New Mexico PR guide*, 1988, p. 14.

- Including students where and how appropriate.
- Practicing the message before recording it if you are delivering it.

Hints

Good radio/TV, like good public relations, necessarily requires sound ideas, a unique approach and a polished performance.

- Ask for radio time which will reach the audience for which you are writing. A good program or spot is good almost any hour.
- Television results in larger audience response than any other medium of public relations, so it may be best for your purposes.
- Know your radio/TV station—the kind of programming they carry is important.
- Know what you wish to accomplish in your radio/TV program.
- Designate a liaison person to work with the station.
- Watch the timing of your program/message.

Making an Appearance on Television

The key to handling yourself when actually appearing in a TV news interview or on a public service program can be boiled down to two words: BE NATURAL. As much as you can, try to regard the television camera as only an incidental part of the overall scene. Generally speaking, concentrate on the person who is doing the questioning or interviewing and respond to him or her as you would to anyone else asking you something. The camera operator will take care of making certain you look and appear "right."

Interview Tips

Interviews on TV and radio can be very effective. Proper preparation however is absolutely essential. Remember that audience interest is the producer's primary concern. To be interesting and properly prepared, become familiar with the program's style and focus by watching/listening to a few shows before your own interview.

If possible, try not to speak from notes or a written draft. If necessary, go over your thoughts in your own mind (and in your own words) before you answer a reporter's or interviewer's question. Often you may ask the interviewer to go over the questions he or she wants to ask beforehand. That way, you have an idea what the person wants to know. That person will also have an idea about what you will answer. If you feel you must have notes to refer to, put them on 3 x 5 inch cards and try to make them as inconspicuous as possible during your appearance.

Interview Hints

- **Know subject**
- **Prepare thoroughly**
- **Follow interviewer's lead**
- **Be enthusiastic**

Let the interviewer "lead" the conversation. Make sure your answers are short yet complete and to the point. Watch the interviewer for time signals. If the interviewer says "our thanks to Mr..Ms. Jones for being with us today," it is an obvious clue that the interview is over. Remember to thank the host for allowing you to appear on the program. (This may be omitted when filming interviews for TV news programs).

Above all, appear interested in and enthusiastic about your subject. Remember, the impression you make may also be the impression many viewers get of the school you represent.

Some additional tips for the interview[1] include:

1. Be prepared with Technology Education facts, teachers' names, graduation requirements, course descriptions and all available information on industrial technology/technology education as it relates to your school district. Provide typewritten copies of this information to the reporter.
2. Be prepared with a one- to two-paragraph description of industrial technology/technology education in lay terms. Know this information well enough to convey it in your own words in response to the probable question: "What is industrial technology/technology education?"
3. Answer only the question at hand. Be precise and concise. Do not evade the issue or question, or start on a different tangent.
4. Answer only those questions within your scope and for which you are prepared. If you do not know, say so, and offer to get back to them with the information. Honesty is clearly the best policy when dealing with the media.
5. Be as helpful as possible. To assist the reporter, provide names and telephone numbers of industrial technology/technology education officials who may be able to answer a question you cannot.
6. When given the opportunity, re-emphasize key points.
7. Emphasize the positive as much as possible.
8. Include as many catchy phrases, slogans, and "quotable quotes" as possible. These give reporters useful side bars and headlines.
9. Remember that you are in control of the situation because you have the answers. In other words, do not let the reporter use you to address education issues that are irrelevant to Technology Education.
10. Remember, if you do not want a statement printed or broadcast, do not make it. Make NO off-the-record comments.
11. Make students and faculty aware of any stories that will air on radio or television and prominently display all print articles at the school. Videotape television coverage and record radio programs.
12. Send the reporter a letter of thanks for the time he/she has given you, even if the story is not aired or printed. The reporter has no control over the fate of the story once it is submitted.
13. When a new phase or project is undertaken in the Technology Education Department of your school, repeat the process of informing the media. A new project may very well merit an additional story.

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[1] Adapted from *Technology education public information handbook*, NYS, p. 18-19.

14. Remember to record the reporter/interviewer's name, address, phone and media affiliation for subsequent contact.
15. When preparing for a television interview, dress comfortably. Avoid elaborate print ties or clothing. Also avoid whites. Don't chew gum or smoke.

News Releases

These should be used regularly to keep local papers, radio and television stations, organizations and other such entities informed of interesting events. The *TSA chapter handbook* provides some useful hints (only some of which are highlighted here) that are generalizable to all forms of news releases. For example, factual releases might include:

- Program and course revisions
- Equipment and/or material donations
- Student organization contests and/or results
- Association officers and election results
- Student service activities
- Open houses
- Advisory council appointments and meetings

By contrast, the *TSA chapter handbook* suggests that feature releases "are more descriptive and 'feature' a special event, person, story or opinion." Because of this, they require more time and effort to develop and they also demand more commitment from the people/organization "running" the feature. To avoid wasting time and effort, always secure commitment for using a feature before developing it. Personal contact is best for securing such commitment. Examples of features can include:

- A successful graduate
- A major program revision
- Actual program benefits for the student
- Coping with change
- Understanding the new technology

Tips for a news release[1]

Five points are important to a good news release: Who, What, When, Where, and Why. If possible, a sixth, How, should be included. It is important to get all these points in the first sentence or two, no matter what medium is being used. A good lead-in captures the attention of the reader or listener and makes him/her want to know more. Be short, concise, and to the point. The key variables determining the success of a news release include:

- Public interest in the event
- Availability of space/time in the news medium
- Significance of the event/topic
- Quality of the release

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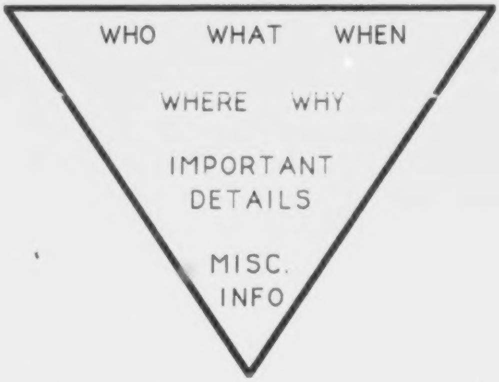
[1] Adapted from *TSA chapter handbook.*

Use short titles to catch readers' attention. In the first paragraph, give enough information to develop the reader's interest. Then, in the second and third paragraphs, form the main body of the release. Give all the relevant details—Where to meet, at what time, what activities are to be performed, etc. Finally, the fourth paragraph should include the concluding statements, why the information is important, and how individuals might benefit or share in this experience. The document, *Technology education in the spotlight* (p. 18), suggests other hints for effective news releases:

- Personal contact with the editor
- Knowledge of deadlines
- Keeping scrapbook/file of article/news release ideas
- Linking the program's PR activity to the school's journalism courses

Figure V-12

News Release Structure



Writing News Releases

Now go into the details of your story. Each succeeding paragraph should be of declining importance as you write (Figure V-12). If the editor cannot use the whole release, he/she can then cut from the bottom—where the least important details are given. Write short sentences and paragraphs. Do not try to dazzle the public with words. Two sentences make a good paragraph in a news release. Be as brief, but as concise as possible. Be accurate and objective--avoid opinionated statements and adjectives. If an opinion must be included, attribute it to someone. Also be careful to avoid jargon, especially educational phrasing that may confuse the reader.

News Release Hints

- **Include photos & names**
- **Equipment & people are photogenic**
- **Send copies to state supervisor & principal**
- **Work well in advance**

Make sure that you have exact dates in a news release: June 10 rather than "next Thursday or tomorrow." Specify "October," not "next month." Check your story for accuracy on every point. Never guess on places, names, dates or times. Give the name of a person, address, and phone number. The editor may need to verify a statement or seek additional information.

Samples of different news releases are provided in Figures V-13, 14, 15 and 16. Teachers can use or adapt them as appropriate for their circumstances.

Figure V-13

Sample Press Release[1]

Progressive
Schools

Progressive City Schools
Anytown, MO 60000

For immediate release

Date: ~~~~~~~~~~~~
Contact: ~~~~~~~~~~~~
Telephone: ~~~~~~~~~~~~

The industrial technology/technology education faculty at *(name of school)* have announced the addition/revision of industrial technology/technology education to/in the junior and senior high school curriculum, according to *(name of superintendent)*, superintendent and the program supervisor, *(name of supervisor)*.

The new curriculum will offer students hands-on learning experiences leading to technological literacy, so essential to careers in the scientific and technological professions, and to life in the information age.

industrial technology/technology education will expose students to broad-based, transferable skills, including research, problem solving, creative thinking and decision making. At the high school level, this new basic will offer systems courses where students will explore the complexities of communications, production and transportation systems through applied experience. Foundation courses providing an overview of the sources and the application of energy, electronics, and technical drawing will also be offered.

Students will study technology through hands-on learning activities. They will also take field trips to technology-based industries to gain first-hand knowledge. They will be challenged to solve problems through research, analysis and the application of mathematics and science concepts.

(name of principal), principal of (*name of school)*, noted, "All our students will benefit from this new course of study as they prepare to live and work in the 21st century. We are particularly excited about the competitive edge this new discipline will offer our students who are interested in pursuing careers in the technical professions."

Parents and other interested individuals may obtain additional information concerning this new educational approach to learning to live in a technological society by calling *(name of school)* at *(telephone number of school)*.

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[1] Adapted from *Technology education public information handbook*, NYS, p. 15.

Figure V-14

Sample TSA News Release[1]

Progressive Schools

Progressive City Schools
Anytown, MO 60000

FOR IMMEDIATE RELEASE _________ ADDRESS ___________________

CONTACT ___________________________ PHONE ___________________

Members of the ____________________ chapter of the Technology Student Association (TSA) will hold a dinner meeting at ____________________ for the purpose of forming their new chapter.

The dinner starts at _________ with (guest speaker) of ____________________ speaking on the subject of ________________________. The new TSA Chapter was formed on ___________________ with _________________ acting as the chapter advisor. The guest speaker, __________________________________ of __________________________ has been appointed to serve on the TSA Advisory Committee because of his/her expertise in the areas of ____________________ and ________________________.

The chapter has already elected officers. The dinner meeting will also serve as the installation meeting for these new officers: president, __________________________; vice-president, ________________________; secretary, ________________________, treasurer, ________________________.

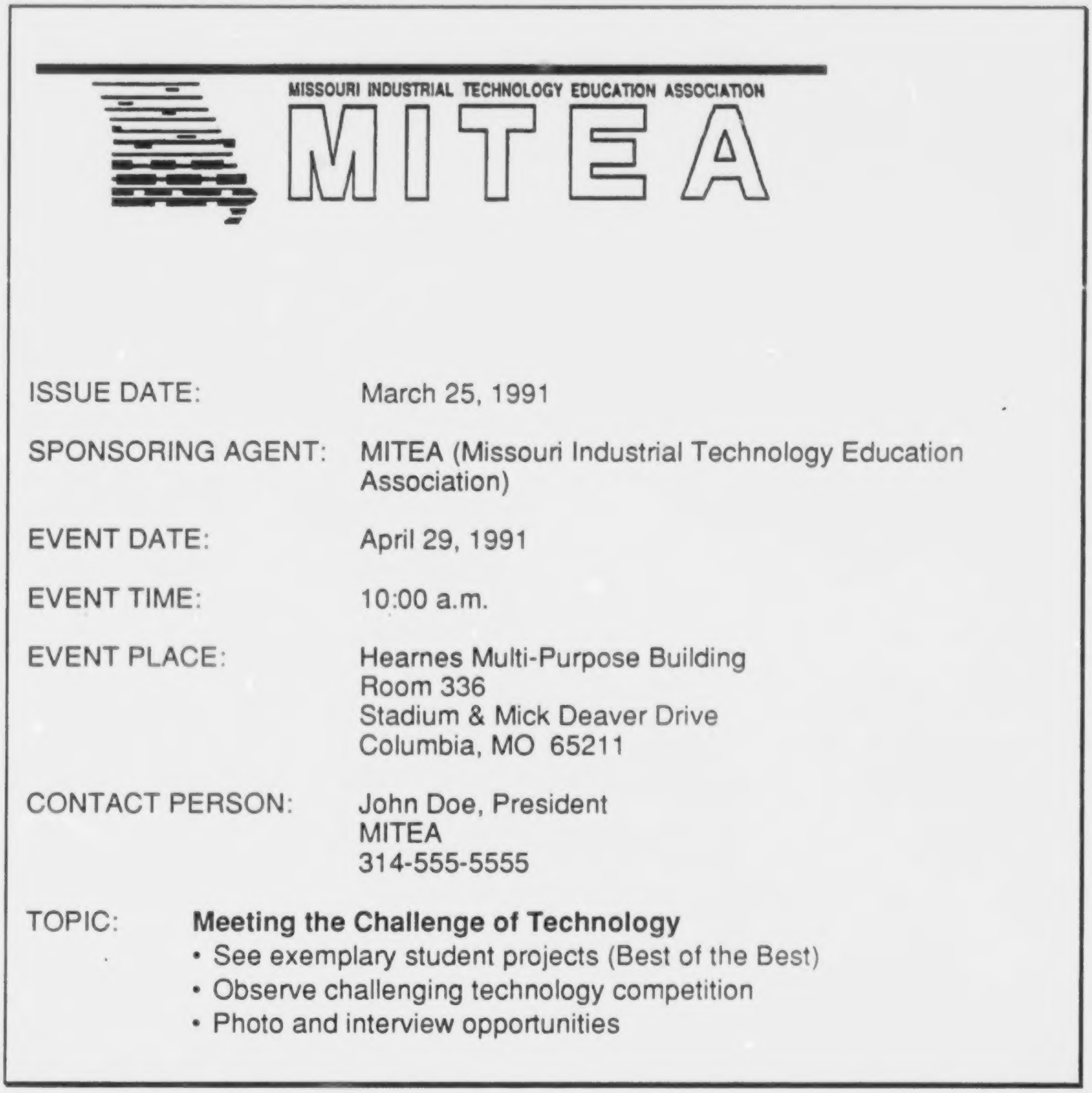
The next regular meeting of the _____________________________ Chapter of TSA is scheduled for ________________ in the meeting room at _____.

---

[1] Adapted from *TSA chapter handbook.*

Figure V-15

Full Page News Release[1]



MISSOURI INDUSTRIAL TECHNOLOGY EDUCATION ASSOCIATION

MITEA

ISSUE DATE: March 25, 1991

SPONSORING AGENT: MITEA (Missouri Industrial Technology Education Association)

EVENT DATE: April 29, 1991

EVENT TIME: 10:00 a.m.

EVENT PLACE:
Hearnes Multi-Purpose Building
Room 336
Stadium & Mick Deaver Drive
Columbia, MO 65211

CONTACT PERSON:
John Doe, President
MITEA
314-555-5555

TOPIC: **Meeting the Challenge of Technology**

- See exemplary student projects (Best of the Best)
- Observe challenging technology competition
- Photo and interview opportunities

---

[1] Adapted from *Technology education in the spotlight*, 1990, p. 19.

Figure V-16

Sample National Science & Technology Week Releases[1]

National Science & Technology Week:
Nov. 9-14, 1991

During the week of November 9-14, Missouri is going to be an exciting place. The emphasis of this week is to focus attention on the demanding role of technology in our rapidly changing society.

Many school districts throughout the state will sponsor open houses and technology fairs. The North County Technology Students Association is providing a guided tour of the new industrial technology laboratory from 7-9 p.m. on Nov. 10. Please contact John Doe for further information at 555-5555.

Sample Technology Speaker News Release

Anywhere University's Chapter of the American Design Drafting Association will bring in John M. Wagner from Reportgraphics, Inc., to speak about the storage and retrieval systems for technically drawn data. Wagner will speak on this subject from 5-7:30 Nov. 12, 1981, in the College Ballroom. The public is invited to attend.

Many other activities are also scheduled. Look for future announcements in the *Anywhere Times*. This is an excellent opportunity for you to explore the industrial/technological world. Plan an activity during National Science & Technology Education Week, Nov. 9-14, 1991.

---

[1] Adapted from *A handbook for public relation programs*, 1982, p. 6.

5. Meeting-based PR Program Elements

Presentations

Individual and/or group presentations can be one of the most valuable components of a public relations program. Certainly they are among the most flexible. Develop a good network of people active in various public organizations because they are also the ones who can facilitate your being offered a "program" slot at their meetings.

The following five steps[2] should be considered when preparing a presentation:

1. Define your purpose
2. Analyze your audience
3. Research your topic
4. Organize your presentation (samples in Figures V-17, 18)
5. Write, design and revise

Given that part of ITE/TE's discipline involves communication technology, it is imperative that your presentation includes **quality**, high-impact visuals. Other tips for successful presentations include those (*Technology education in the spotlight*, p. 13 & 14), listed below. Additional details and recommendations for slide and video presentations are available from Kodak.

> **Individual and/or group presentations can be one of the most valuable components of a public relations program.**

- Knowing your audience
- Careful preparation
- Effective organization and content
- Quality visuals
- Respect for time allocations
- Stressing what you have to offer (instead of what you want)
- Allowing time for questions and answers or otherwise providing for interaction

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[1] Adapted from *New Mexico PR guide*, 1988, p. 12.

[2] Eirich, 1991.

Figure V-17

Sample Presentation to Parents and/or School Board[1]

1. **What is Technology Education?**
   - A. A study of technological systems and their impacts on our society
   - B. Required for all students at the junior high level
   - C. Elective courses at the high school level
2. **Important Skills and Issues Addressed**
   - A. Provides a logical, systems-based approach to analyzing technical problems
   - B. Is experienced-based, hands-on learning
   - C. Is an integrating discipline which utilizes skills and information learned in math, science and social studies
   - D. Focuses on broad-based, transferable skills such as communication, problem solving, creative thinking and decision making
3. **Middle/Junior High Program**
   - A. One unit required of all students by the end of Grade 8
   - B. Highlight the local course's content and activities (provide handout, pictures, & samples)
4. **High School Program**
   - A. May be used to meet the practical arts requirement for high school graduation
   - B. Both systems and advanced courses are presented
   - C. Many potential electives are available/possible (provide handout)
   - D. Articulates with vocational and technical secondary/post-secondary programs
5. **Conclusion**
   - A. Technology Education is an engaging motivational curriculum that builds a technologically literate citizenry
   - B. Questions and answers

* (Approximately 45-60 minutes, including 15 minutes for questions and answers)

---

[1] Adapted from *Technology education public information handbook*, NYS, p. 9.

Figure V-18

Sample Speech Organization

HOW TO ORGANIZE A SPEECH[1]

STEP 1
Analyze audience
Determine special interest of the audience
Establish the amount of time you will have

STEP 2
Establish general purpose
INFORM ? PERSUADE ?

STEP 3
Establish specific purpose
To inform (who) about (what). To convince (who) to take (what action)

STEP 4
Identify approach
To discuss major factors of interest to the audience To review benefits to the audience

STEP 5
List major points (For long speeches you will have more points)

Point 1	Benefit 1
Point 2	Benefit 2
Etc.	Etc.

STEP 6
Provide supporting data

Point 1	Benefit 1
A.	A.
B.	B.
Etc.	Etc.

STEP 7
Develop conclusion and summarize major points
Review benefits, then highlight actions you want the audience to take

STEP 8
Outline speech

STEP 9
Rehearse out loud
Check time
Go back and revise as necessary

---

[1] John Mohr.

Town Meetings[1]

Technology education's public relations efforts seek to address all constituencies affected by technology. Often we seek consensus on rationale, needs, goals, and necessary actions. By working together, a community can achieve locally agreed-upon goals. Such a group effort can often best be launched in a "town meeting" setting.

Meetings should include not only technology educators, but teacher representatives from all grade levels (K-12), particularly including science and mathematics and elementary teachers; school principals, other school personnel; personnel from local businesses and industry (e.g., banks, machine and repair shops, industrial plants, real estate offices, etc.); and representatives of civic groups concerned with various subjects relating to education (e.g., chambers of commerce, parent-teacher groups, minority organizations, churches, etc.). Invitations are best made on a person-to-person basis.

The most important element of successful town meetings is the program, or rather, the structured lack of a formal program. First, the meeting should have a compelling central theme to which all present will instinctively feel that they have something useful to contribute. "What can we do together to improve our children's preparation for the technological future?" is one example. A sample agenda is shown in Figure V-19.

Next, it is critical that "presentations" be held to an absolute minimum and that all participants be provided the maximum opportunity to contribute. This is accomplished by agendas that include example group discussions, and a clear, measurable objective. All should share a feeling of competence in undertaking the task, and a feeling of accomplishment upon its completion. Permit open-ended discussion so that all feel free to express themselves. If the group is large, it is helpful to break it into smaller groups of 5-8 to promote participation but be sure to provide for overall sharing of input..

> **First, the meeting should have a compelling central theme to which all present will instinctively feel that they have something useful to contribute. "What can we do together to improve our children's preparation for the technological future?"**

Successful meeting should have closure. Some clear action agenda for follow-up must result, either through a summation and statement by the planning group or as a result of a final assignment to the assembled meeting participants. This, of course, reinforces the need for the planners to have in mind a clear idea of the objectives which the town meeting is intended to accomplish.

Other elements which will help promote success include providing for participant recognition through the local media, and assuring that all participants receive a printed summary of the proceedings, along with a letter of thanks.

Town meetings accomplish much. Non-school people from all sectors of society appreciate being asked for their advice and opinion. This enhances local educational support. Technology education teachers have their self-image bolstered, and do not feel isolated from the "world-out-there" or from teachers of other subjects. Communication is permanently increased: between educators and non-educators; among teachers of all grade levels and subjects; among teachers, administrators, and school board members; and among various sectors of the local economy. And, most important of all, many locally pertinent ideas for action and sharing of resources will inevitably result. Properly planned, conducted and followed-up, town meetings can be very successful for both public relations and for actually accomplishing key goals.

---

[1] E. C. Stoever, Jr.

Figure V-19

A Sample Town Meeting Agenda

Improving Technology Education in Our School/Community

6:00	Dinner
6:45	Introductions (Readable place-cards and/or nametags will be helpful)
6:50	Explanation of meeting purpose and format
7:00	Discussion Question 1. e.g., What should be the objectives of technology education? (If the group is large, break into small groups of 3 to 5, and follow with a five-minute summary session for sharing and interacting.)
7:30	Discussion Question 2. e.g., What are five specific actions which will enhance attainment of these objectives in our school/ community? (Conduct in small heterogeneous groups, as desirable)
8:00	Discussion Question 3. e.g., What resources are needed/ available for performing these actions? (Conduct in small heterogeneous groups, as desirable)
8:30	Discussion Question 4. e.g., Who will do what, and when? (Conduct in small heterogeneous groups, as desirable)
9:00	Summation
9:15	Adjournment

Displays & Exhibits

Because our students work extensively with the artifacts of technology, we invariably have convenient access to things; e.g., computers, robots, cut-aways, student projects, industrial products and the like. Combined with our field's graphic communication capabilities, this allows us to develop eye-catching displays relatively easily.

Effective locations are necessary to obtain the maximum benefits from displays. They include: shopping malls, store windows, library display cases, community/public buildings, commuter areas (airports, rapid transit stations, ...), conferences and trade shows.

Planning displays and exhibits is absolutely essential; otherwise, they will look just like what they are, a mere collection of random objects. West Virginia's PR guide suggests:

- Finding out the theme if your display is part of a larger exhibit.
- Deciding on a theme for your own exhibit.
- Establishing what your audience would like to see.
- Deciding what aspect of your program would appeal to the audience.
- Deciding what materials you will use for the display.
- Drawing up a plan—securing the height, depth, length of the space to be used.
- Building and installing the exhibit to get your point across.

Exhibits can be a chore or a challenge. The way you approach the assignment will determine which it is for you. Planning for effective use of displays requires that the following questions be answered carefully[1]:

WHO? (Who is the audience we are trying to address?)

To reach people through activity

To save time in getting your story over

To stimulate people to find out more about your program

WHERE? (Where will the PR activities take place?)

In any central location in the community

In an organized meeting, fair, or convention

Simple window display

An occasional advertisement to reach the non-reading public.

HOW? (How are we reaching the audience?) By exhibits which involve:

Action—persons performing at machines, a flashing light, a film or slide projector, a push-button, equipment in action, videos, good lighting

Objects—made by pupils; classroom equipment; models of new buildings

Photographs—showing projects and activities of your program—include concise descriptive placards

---

[1] Adapted from *Promoting vocational education*, WV, p. 18.

Figure V-20 is a display checklist, adapted from *Technology education in the spotlight*, p. 15, that will be useful in maximizing the effectiveness of ITE/TE displays:

Figure V-20

Display Effectiveness Checklist

☐ Don't use many statistics—comparisons by picture are better.

☐ Keep the exhibit simple and uncluttered—too much detail discourages people from looking and understanding.

☐ Use movement or special activities to gain attention.

☐ Combine many techniques—color, action, photographs, video, etc.

☐ Use unusual ideas, materials and approaches to interpret your program.

☐ Use many people—the art teacher, the advertising club of your city, the dramatics teacher, the display company—for ideas and assistance.

☐ Schedule teachers or students at the exhibit to explain the program—use an amplifier when necessary.

☐ Have some "hand-outs" if you have a booth for an exhibit. Make them attractive and simple to understand.

☐ Provide some appropriate follow-up activity such as:
  - A visit to the school.
  - A conference with the vocational counselor.
  - A trip to the vocational program or department.
  - A service of some kind connected with your subject and/or your specialty.

☐ Visual organization—related items are grouped.

☐ Background sets tone and helps organize space.

☐ Display text is neat and large enough to be read from a distance.

☐ Some important objects are displayed at eye level.

☐ Lighting is adequate and contributes to mood/message.

☐ Moving elements are reliable.

☐ Overall impression is quality (no rough edges!).

Open Houses[1]

Many people consider open houses an effective way to bring the public into a technology center. Open houses can be done in a variety of ways, but the most important thing is to advertise them well so that you have a good turnout. Some hints for organizing open houses include:

1. Contact various news media for coverage announcing the open house.
2. Send announcements to all parents, community groups, businesses, and industries well in advance of the event. Then send out a written reminder to arrive 10-14 days before the event.
3. Arrange several stories about how teachers and students are preparing for the open house.
4. Have students attend and be available in their classrooms to demonstrate activities.
5. Have a display of brochures outlining your offerings and goals.
6. Have a map of the ITE/TE facilities and displays available.
7. Refreshments should be served.
8. Provide tour guides for those who would prefer a more organized approach.
9. Arrange for TV, radio, and newspaper coverage.
10. If you expect a large crowd, have people on hand to direct parking.
11. Use signs to direct people through halls.
12. Have someone available at the door to greet people when they come and leave.
13. Have exhibits and displays located throughout the building showing talents of students.
14. Set the time for the convenience of the community--not the staff's. Avoid conflicts with major community events.

These are by no means all the hints in developing an effective open house. As with any public relations activity, your creativity and imagination are important.

Recognition Program/Banquet[2]

Dinner meetings and recognition banquets are a frequently used event.

1. Involve students in all aspects of the planning and handling of the banquet.
2. Work out a long-range plan for financing the annual banquet.
3. Keep the superintendent, principal, and other school authorities informed as to all plans for the banquet.
4. Have attractive and appropriate invitations. Send them well in advance of the date of the banquet.

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[1] Adapted from *Promoting vocational education*, WV, p. 19.

[2] Adapted from *A handbook for public relations programs*, 1982, p. 29.

5. Plan decorations which students can make.
6. Have students design and mass produce a "favor" to give all guests of the banquet. Design special ones for the major guests.
7. Arrange for a welcome committee.
8. Plan entertainment or a tour of the facility for early arrivals.
9. Use name tags to help guests get acquainted.
10. Have the department open before and after the banquet, if it is held at school.
11. Plan a varied program that moves fast. Set a time limit.
12. Plan for a "stretcher" or "relaxer" during the program.
13. Keep a file of banquet programs, menus, and decorations used. Keep a file of banquet ideas for future use.
14. Publicize the banquet before and after. Take pictures during the banquet, or have students take pictures for this part of the effort.
15. Prepare certificates of recognition for students who assist in the banquet, speakers, special guests and others who help in some way. If possible, have them printed in the graphics department or commercially.

6. Resources

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_____. (1982). *A handbook for public relations programs.* Reston, VA: American Industrial Arts Association.

_____. (1985). *Marketing handbook for independent schools.* Boston, MA: Boarding Schools. [ED 291166]

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_____. (1988). *PR guide geared to vocational educators.* Albuquerque, NM: New Mexico Council on Vocational Education.

_____. (1989). *Plug into PR: NJLA public relations handbook.* Trenton, NJ: New Jersey Library Association. [ED 293547]

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_____. (N.D.). *School PR planning.* Arlington, VA: National School Public Relations Association.

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Brodhead, C. W. (1984, November-December). Polishing the image. *VocEd, 59*(8), 49-51.

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Kohn, R. T. (1982). *Have you got what they want: Public relations strategies for the school librarian/media specialist.* Metuchen, NJ: Scarecrow Press.

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Martin, W. R. (1989). *Handbook on marketing vocational education.* Westerville, OH: Ohio State Council on Vocational Education. [ED 308386]

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Neff, B. D. (1988). *Beyond theory: Improving public relations writing through computer technology.* Paper presented at the Annual Meeting of the Central States Speech Association (Schaumburg, IL, April 14-16, 1988). [ED 297342]

Phillips, C. S. (1985). *Secrets of successful public relations: An insider's guide to the strategies and techniques that work today.* Englewood Cliffs, NJ: Prentice-Hall. [REF HD59 .P45]

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Chapter VI

Teaching Industrial Technology/ Technology Education

STUDENT PERFORMANCE EVALUATION

BREAK-EVEN ANALYSIS
INCOME
COST
QUANTIT
OF ECONOMICS
STAPLETON
ICS

INSTRUCTIONAL METHODS

PLANNING INSTRUCTION

INDIVIDUAL AND SPECIAL NEEDS

TECHNOLOGICAL LITERACY

Chapter VI

Teaching Industrial Technology/Technology Education[1]

1. Introduction & Overview

As most educators know, the principal facilitator of student learning is the classroom teacher. If they are successful in establishing an atmosphere of mutual respect and if they genuinely care for their students' welfare much learning will take place. Part of this atmosphere comes from how classes are taught, some from the materials and methods used, some from the accommodation of individual differences, and some from the provision of equitable instruction for all.

Objectives

1. To highlight in a readily accessible manner the essential elements of effective instructional planning.
2. To feature key guidelines for selecting instructional methods.
3. To present successful strategies for individual instructors to meet student needs.
4. To promote equity and encourage participation by all.
5. To introduce student organization activities and their benefits.
6. To draw attention to the strengthening of employability skills.

Chapter 6 Outline

1. **Introduction & Overview** 1
2. **Planning Instruction** 2
3. **Selecting Instructional Methods** ... 11
4. **Meeting Individual & Special Needs** 14
5. **Providing for Equity** 19
6. **Evaluating Student Performance**... 22
7. **Incorporating Student Activities**....31
8. **Developing Employability Skills** ..33
9. **Resources** 40

Overview

Part 2 of this chapter addresses the planning of instruction. It also lists the types of materials that are helpful in teaching. These materials are listed here to promote their inclusion during the planning process.

Part 3 addresses the topic of selecting instructional methods. Several methods, some new and innovative and some well-proven, are listed with descriptions of how they may be used. Short descriptions of selected techniques are also included to provide a common starting point for teachers in their curriculum planning process.

Part 4 deals with issues involved in meeting the individual needs of students. These individual needs range from different learning modes to provisions for various learning disabilities. This section also lists and describes the various classifications of special needs students. The intent is to inform ITE/TE instructors of common traits of typical disabilities in order to better enable them to recognize, obtain assistance for, and service students with disabilities and disadvantaged individuals.

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[1] The MOITE Guide development team appreciates the work of Mr. David Baird in initially drafting key elements of this chapter.

Closely related to the topic of special needs is the moral and legal requirement to provide equitable educational experiences for all groups. In this chapter's part 5, the topic of equity for all groups, whether based on sex, race or minority, is addressed.

In Part 6, attention is turned to the important task of assessing student learning, i.e., evaluating student performance. Then this chapter, in part 7, highlights the topic of student organizations and activities. The purposes and goals of the Missouri Industrial Technology Education Student Association are listed. It is emphasized that many of this group's activities should be co-curricular, involving other educational areas such as mathematics, history, or English as they reinforce the ITE/TE curriculum.

This chapter focuses on the instructor's choice of teaching method/activity. As such, it builds on the documentation detailed in Chapter II.

The final part of this chapter, part 8, deals with teaching basic employability skills. These skills, the actual foundation of general working and vocational competence, are those required for successful job seeking and retention and they represent a significant affective, pre-vocational outcome from participation in our curriculum. Then, following this guide's established pattern, part 9 lists selected resources teachers can turn to for additional help on any of this chapter's main topics.

2. *Planning Instruction*

Planning instruction for an Industrial Technology/Technology Education program should be no different from the processes used for any other classroom/laboratory course. Theory and common sense indicate that a variety of methods must be used in order to provide the widest range of learning opportunities for students with diverse learning styles. By thoroughly planning for educational experiences, consideration can be given to students who are visual learners, auditory learners and those who prefer learning through kinesthetic (hands-on) activity.

Chapter II's part 6 describes the documentation needed for appropriate planning and instruction to take place within the ITE/TE classroom/laboratory. Specifically, it describes the contents and functions of courses of study, major units, instructional modules and lesson plans. Essentially Chapter II provided guidelines for planning the curriculum i.e. the "what" (content) to teach. This chapter (VI) focuses on "how" to teach. As such, the following pages detail guidelines to help the teachers decide on teaching **methods** and materials and then the evaluation of student performance.

The following is a list of instructional support materials commonly used by industrial technology education programs. Each carries implications for the use of specific instructional strategies. It is apparent from this list that instructional materials are quite diverse and provide a variety of choices for adoption into instructional lessons. ITE/TE instructors are encouraged to use the broadest range possible in order to meet the greatest number of student needs.

- technology activity modules (TAMs)
- video-tapes
- audio tapes
- computers
- drawings
- films
- information sheets
- instruction sheets
- CD/ROM
- learning activity packages (LAPS)
- models
- photographs
- reference books
- simulators
- slide tapes
- textbooks
- interactive video
- self-instructional modules
- tools and equipment within specific subject area

The planning of instruction or a delivery system must reflect careful consideration of the principles of learning. Although many have outlined these, one of the most understandable sets was delineated by Dr. Blair of the University of Illinois. Figure VI-1 presents these principles and it should prove to be of considerable assistance to ITE/TE instructors as they plan their instruction.

Figure VI-2's overview of instructional strategies serves to demonstrate the interrelationship between instructional methods and materials. A method of instruction may be selected that suggests the use of several materials appropriate for the technique. Alternatively, a material item that is especially effective may be selected which in turn will dictate one or more methods of instruction. Both approaches are appropriate and should be used in order to create the optimum learning environment.

Figure VI-1

Blair's Principles of Learning[1]

1. We learn to do by doing.
2. We learn to do what we do (and not something else).
3. Without a sufficient stage of readiness, learning is inefficient and may even be harmful.
4. Without motivation there can be no learning at all.
5. For effective learning, responses must be immediately reinforced.
6. Meaningful responses are better learned and retained longer than less meaningful ones.
7. For the greatest amount of transfer learning, responses should be learned in the way they are going to be used.
8. An individual's responses will vary according to how he/she perceives the stimulus (situation).
9. An individual's responses will vary according to the classroom atmosphere.
10. Every person always does the only thing he/she can possibly do considering their physical inheritance, background of learning and the forces that are acting upon them.

---

[1] Dr. Glen Blair, University of Illinois-Urbana.

Figure VI-2

Overview of Instructional Strategies[1]

LECTURE

DISCUSSION

LABORATORY

DEMONSTRATION

INSTRUCTIONAL ACTIVITIES
(Individual/Group)
- Read
- Write
- Illustrate
- Practice
- Observe
- Buzz Sessions
- Brainstorm
- Role Play
- Simulation
- Interview
- Survey
- Student Panel

PRINTED MATERIALS:
- Text and supplementary books
- Manuals and workbooks
- Handouts
- Articles and pamphlets
- Magazines
- Modules
- Programmed Instruction
- Games
- TAMS
- Learning Activity Packages (LAPs)
- Job Sheets
- Information Sheets
- Assignment Sheets
- Tests
- Quizzes
- Posters
- Encyclopedias

PEOPLE AND PLACES OUTSIDE THE CLASSROOM:
- Guest Speakers
- Panel Discussion
- Guest Demonstrators
- Interviews
- Work-Experience

INSTRUCTIONAL TECHNOLOGY:
- Filmstrips
- Computer-assisted learning
- Interactive videos
- Films
- Sample kits
- Films
- Television
- Video-Tapes/Recording
- Slides
- Slide/Tape Shows
- Audio Cassettes
- Photographs
- Opaque Projector
- Filmloops
- Overhead projection in transparencies
- Models

Select or combine resources, methods, and activities to design LEARNING ACTIVITIES

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[1] Based on *Introduction to Vocational Education Instructional Management*, 1984.

A Sampling of Methods

Field trips

Utilize field trips for more than observation of industrial processes. Use discussion and oral or written reports on the various occupations involved in the process observed. Bring back the industry or technology with modern communications technology, e.g., video-tape.

Guest speakers

Have one or more speakers address the class about past or present occupations and the training and skills required to function in them. Have them bring out the rapidity of technological change and highlight emerging technology.

Student personnel system

When setting up the organizational chart, try to emulate industrial organization and procedure. Provide specific information on the occupations involved.

Interviews

Require students to interview people involved in various occupations. Have them make written or oral reports to the class. Provide guidelines for the format of interviews. Include questions about how one best prepares for such employment.

Bulletin board

The bulletin board can be an effective teaching method if used properly. Place items on the board that will stimulate interest and questions, something that will make them want to find out more, then provide students with a way to do so. Change your display often!

Class discussion

Class discussions can be interesting and involving for students — if they are carried out in a non-judgmental manner. Listen to what students have to say and try not to dominate the discussion. Set up situations causing students to associate and make applications of the information presented.

Role playing

By means of simulated technological/industrial activity, role playing affords students the opportunity to identify with typical life activities as they exist in various occupations and/or professions. Through role playing, students can experience some of the reality of work responsibilities. It is especially well-suited for use with enterprise laboratory activities, mass production activities, research and experimentation and group project experiences.

Role playing affords students the opportunity to identify with typical life activities as they exist in various occupations and/or professions.

Group project

The group project method involves the designing, planning and development of a product by a group of students. It differs from the mass production method in that only one (or a few) finished product(s) results from the activity of the group. Ideally, the project selected has numerous elements thus permitting the effective use of teams or other sub-groups. The method has been used successfully at the junior high level for studying high volume production industries such as paper and paper products, oil, iron, glass and rubber. At the senior high level, the group project might take the form of designing and constructing a machine, vehicle prototype or other large, even interdisciplinary, projects.

Conceptual learning

Current educational theory emphasizes the need to develop fundamental concepts and skills which have functional value in a wide variety of applications. This learning generally is referred to as conceptual learning. For example, the concept of molding enables the student to relate general knowledge and skills to many specific types of industrial processes such as forging, foundry and casting and in several material realms, e.g. metals, ceramics and plastics. A study of general or fundamental principles insures that loss of specific details will not mean a total loss. The remaining understanding will permit reconstruction of details when necessary. This approach is based on the notion that concepts have greater application to new situations than do specific facts.

> **A study of general or fundamental principles insures that loss of specific details will not mean a total loss.**

Enterprise

The enterprise approach involves a simulation where students assume career roles and solve problems in a manner similar to their counterparts in industry. The enterprise method often involves such activities as research and development, financing, mass production, servicing, communication, transportation, distribution and marketing. At elementary and junior high levels, the emphasis might be directed toward activities of a simplified nature, since only limited time would be allotted for the activity. At the senior high level, activities may be more complex and greater emphasis is placed on tooling and higher technology.

Cooperative work study

Many students enrolled in ITE/TE programs can profit from on-the-job experiences designed to supplement in-school learning. Such experiences assist students in further development of skills and positive attitudes toward work and school. Often work experience helps students in assessing and establishing career goals and this enhances their potential for successful employment in the future. Other significant out-of-school techniques include industrial observation and community projects. All out-of-school industrial experiences require supervision and evaluation by qualified school personnel to ensure that the experience and environment are adequately serving the student's educational goals and that safety and other safeguards are provided.

Seminar

The seminar method emphasizes student interaction and contribution. It is used to identify individual problems and to provide for group assistance in finding solutions to these problems. The seminar provides a continuing opportunity for student peer evaluations as well as presentation of individual student progress With the seminar method, the teacher(s) assume(s) the role of facilitator, observer, evaluator and advisor. In the seminar students become involved in challenging, questioning, assisting and discussing. The method has been used successfully in combination with the enterprise, group, interdisciplinary research and experimentation and other more traditional instructional methodologies.

Individualized instruction

Individualized instruction provides for the varying abilities and interests of students. It involves development of self-instructional units or modules in a manner which enables students to independently: (1) pre-assess their performance and knowledge of the objectives, (2) progress through specified learning activities at their own pace, and (3) assess their own terminal performance and achievement of unit objectives. Missouri's TAMS capitalize on the benefits of this approach. A variety of hardware and software systems have been developed to facilitate management of the instructional approach. These include auto-tutorial systems, interactive video, tape-slide, tape-filmstrip, programmed references, student contracts, learning activity packages, educational games, and computer-assisted instruction. All have great potential for helping students learn and consequently their use is strongly encouraged.

Instructional Guidelines

A delightful source on useful teacher hints that can effectively guide the instructor as he/she plans their teaching methods is found in Tischler's pamphlet entitled *Thoughts on Learning*... He has assembled a set of valuable insights but then he has moved beyond mere summary by highlighting their **implications** for teachers. Figure VI-3 presents a sample selection of these.

Figure VI-3

Tischler's Thoughts on Learning[1]

PRINCIPLE:

The whole does not necessarily equal the sum of the parts. Example: *You can teach a student all about nails, screws, lumber, windows, doors and paints and he /she still cannot build a house (a system).*

APPLICATION:

Any subject to be taught is like fitting together the pieces of a puzzle. Organize your materials so that the student first sees only the system without the details. Details often require specific skill development or prerequisites neither of which the beginner may have. Later relate each detail to its place in the system.

PRINCIPLE:

The teacher is like a person standing on a cliff watching a canoer navigate a turbulent twisting river. From the teacher's vantage point, he/she sees the whole (the overall concept) of the problem. The student, like the canoer, experiences one surprise after another. Each turn is a new challenge. Each moment is loaded with anxiety and surprise. Oh, for the student to have the vantage point of the teacher.

APPLICATION:

Before starting a curriculum, a course, or a lesson, develop the concept theme. Arrange your activities so that the student is standing on the hill looking at the overall subject matter before starting into the details. Then, from the student's vantage point he/she should be better able to determine his/her future plan of action or reaction.

continued...

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[1] Tischler, *Thoughts on Learning*, n.d.

Figure VI-3, Continued

Tischler's Thoughts on Learning

PRINCIPLE:

When one approaches learning as an opportunity to "discover something" rather than the task to "learn about something," the feeling of self-reward takes over, thus causing a greater interest and in-depth investigation.

APPLICATION:

The teacher should organize his/her subject to excite the student toward the thrill of discovering some new thought or idea. The student will thus be motivated to learn. Discovery through learning causes a behavioral change. Repeating of facts may be dull and not contribute to learning. Discovery may lead to disappointments, but it also may lead to the thrill of greater discoveries.

PRINCIPLE:

Tell the student what and how you are going to teach him/her. Teach the student what you told him/ her you were going to teach him/her. Tell the student what you taught him/her.

APPLICATION:

Before teaching subject matter, explain how you have organized your program and what methods of teaching you will be using. You cannot expect the student to learn, when he/she doesn't know how you expect to teach him/her. Then be sure to follow the methods you have outlined, and summarize by telling what you have taught.

PRINCIPLE:

Learning is easier and more effective when the student uses two or more of his/her sensory transducers.

APPLICATION:

For any subject, present your material so that you require the student to use as many of his/her senses as possible. Hearing provides about 15% perception, seeing 60%. Don't stop with these. There is still 25% more reception to tune in on: touch, smell, taste and the emotions.

PRINCIPLE:

For education to be meaningful, it must do something for the student in the present. The future may be too far away to be meaningful.

APPLICATION:

Education must pay off now! The fact that it will be helpful later is nice to know, but if education doesn't pay off in the present — the same type of education may not apply for the future.

Education must be meaningful — not a promise. If you teach Algebra I because it is a need for Algebra II then the program is doomed to fail, since it provides no compensation right away; only a promise for a future goal.

PRINCIPLE:

An explanation of subject matter, even today, is composed of a too large a proportion of words and too small a proportion of understanding.

APPLICATION:

Come to class prepared. Know what and how you will present the subject. If you really know this, perhaps it will not take many words. Find better ways to present your subject, by minimizing on words, maximizing understanding.

Figure VI-3, Continued

Tischler's Thoughts on Learning

PRINCIPLE:

Learning starts from an understanding of previous experiences upon which new ideas are built. During the transition ideas are built. During the transition process, material things become less important, and meaningful verbal expression becomes more important.

APPLICATION:

The beginning student needs a variety of activities. The retention span appears short. Use several activities to present the same material. For example: *Present the abstract; validate the information by experiment. Then apply the theory, method of relating the experiment, to an actual application. In the laboratory the student tests the teaching, book, film, etc. In the application the teacher should test the student.*

PRINCIPLE:

One cannot cover some subjects in full, even in a lifetime, especially if coverage means considering all the facts and their applications. Therefore, be selective and remember that education is cyclical, the student will return again-and-again to the subject at later dates.

APPLICATION:

Remember that your teaching occupies only one segment on the educational yardstick of time. Don't cram too much in at one time. Cover the most meaningful points at this stage of development of the subject. The student will return to the subject later as the spiralling cycle of education continues.

PRINCIPLE:

Learning is not obtained through a single inoculation: Once you've had it, you won't need it again. Booster shots are needed to assure continued proper response by the learning system.

APPLICATION:

Don't expect the student to remember the facts just because you taught them once before. From time to time you must reinforce the information previously taught. Remember the bucket you are filling may have a slow leak. Some leaks may not be so slow.

PRINCIPLE:

Understanding human memory is quite complex. One thing is certain, unless a detail is placed into an organized structure, it is soon forgotten. The organized structure is a SYSTEM.

APPLICATION:

Decisions can be made based on a broad conceptual understanding providing the known facts are all part of a system. Try to build them to an existing system. Children learn by systems from birth. The system of walking, talking, eating and sleeping are all detailed, systematic processes. Without knowing the details the child is able to learn. Teachers, on the other hand, often feel the student won't understand unless he/she is first given all the details.

PRINCIPLE:

The development of a CONCEPT depends upon the study of the relationship between seemingly unrelated facts. The concept grows broader as these relationships come closer together.

APPLICATION:

The learner may not see the relationship between seemingly unrelated facts. The teacher can show how these facts fit together so as to help the learner develop an overall understanding (a concept). The tighter the relationship is brought together the better the understanding of the concept.

3. *Selecting Instructional Methods*

Success in the classroom/laboratory depends on many factors. Foremost among these is hard work on the part of the teacher. Educational programs must be adaptable. They must be flexible enough to remain workable in all locales, in many types of facilities, and with students possessing differing values and interests. A successful program must be capable of application in all situations and at all levels.

Industrial Technology/Technology Education is concerned with technology, industry, its practices, procedures and products. Within the classroom/ laboratory, student experiences should be tailored to develop understandings, attitudes and skills pertaining to technology rather than to the production of a take-home product (the project). Although a finished product may well be produced by each student, or by a group of students, it is important to remember that the project is not the goal but rather it is a by-product of the process of learning about technology and industry.

Curriculum content is not the only important element in the teaching-learning environment. Because of the differences in pupil learning styles and teacher proficiencies, varied instructional methods must be used and evaluated. Traditionally, many instructional methods have been used in industrial technology education programs. Methods such as lecturing, demonstrating, designing, problem-solving, and constructing individual projects have long been recognized as effective instructional approaches for presenting content. These are being supplemented by emerging instructional methodologies which provide increased potential for developing technological, industrial and career understandings, attitudes and skills.

When developing TAMS and lesson plans for a program, it is essential to decide which teaching methods will be most effective. The instructor has many options, when selecting the appropriate instructional method for each student, and for each type of class. It is important that teachers use more than just those they learned while at college.

The following is a list of methods for adding variety and interest to industrial technology education programs. Combinations and permutations of this list are not only possible, but are desirable and should be encouraged. But methods alone will never be sufficient. The ultimate success of these as well as other techniques depends on the innovativeness, interest and skill the teacher exhibits in presenting the material.

- Community resources
- Conceptual learning
- Conference
- Contract
- Cooperative
- Demonstration
- Discovery
- Discussion
- Enterprise
- Exercise approach
- Field trip
- Inquiry
- Lecture
- Mass production
- Problem solving
- Production
- Research and experimentation
- Role playing
- Seminar
- Student personnel system
- Show and tell
- Team teaching

- Group project
- Guest speakers
- Individualized instruction
- Work study
- Written or oral reports
- Case study

Instructional methods must be selected to capitalize on the unique needs of students in specific locales. The teacher of Industrial Technology/Technology Education programs must be alert to the resources of the community being served. Not only must teachers be alert to resources, they must also be aware of opportunities for integrating these resources into the instructional program. All resources such as speakers, industrial visitations, films, slides, tapes, learning packages and bibliographical resource materials must all be evaluated on the basis of their merit to the instructional program. Figure VI-4 provides some useful guidelines for the selection of teaching methods.

Figure VI-4

Guidelines for the Selection of Delivery Systems[1]

- The best procedure usually is to select the least elaborate and least costly strategy that will apparently enable the learner to acquire the desired capability.
- All things being equal, well-illustrated, step-by-step verbal instructions with feedback to the student constitute the most practical, effective and efficient strategies for most types of learnings.
- If an objective is accomplished in less time with one strategy than another, it is more efficient. If the retention or transfer of the information or skill learned is greater for one strategy than another, then it is more effective for reaching that objectives. When determining the approach to be followed, the best estimate of both efficiency and effectiveness will have to be followed.
- Try to select flexible strategies that can be adapted to student needs, problems and interests.
- Strategies that give students an opportunity to share in goal-setting, learning experiences and evaluation often produce better results.
- Student need an opportunity to work with strategies that provide opportunities to inquire, to analyze, to explore, to be active, to create and to initiate.
- The strategy selected should give the teacher an opportunity to observe student progress

Overall, however, in addition to insuring that key principles such as those outlined in Figure VI-4 are used, ITE/TE instructors also need to compare their decisions to state and national guidelines. Figure VI-5 presents the MO ITE standards, Topic 7, the Instructional Strategies. Instructors are advised to review their own decisions against these recommendations keeping in mind that local differences and student needs may provide grounds for a departure from these standards. However, individual preferences, easiness for the instructor, and simple convenience are not strong reasons for instructional choices.

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[1] *Introduction to Vocational Education Instructional Management*, 1984.

Figure VI-5

MOITE Standards, Topic 7: Instructional Strategies

Technology education and/or industrial technology is designed to help students comprehend technological systems and gain the ability to apply what is learned to real-life situations. Instructional strategies must be carefully selected to allow the student to engage in activities which allow them to utilize technological concepts to solve problems. This standard's statements topic concern instructional strategies i.e., methods utilized to deliver instruction and promote student achievement of goals and objective. The technology teacher plans, implements, and evaluates these strategies.

Fill in marks to indicate assessment: ∇ not met, 0 met, Δ exceeded

1. Teachers plan and prepare written courses of study designed to develop student competencies consistent with program goals and course objectives. ∇ 0 Δ
2. Teachers plan and prepare current lesson plans based upon the course of study and student needs. ∇ 0 Δ
3. Teachers consider alternatives and select appropriate methods to assist students in meeting course objectives. ∇ 0 Δ
4. Teachers develop and/or obtain appropriate, up-to-date instructional materials. ∇ 0 Δ
5. Teachers plan and provide for evaluating the effectiveness of their instruction. ∇ 0 Δ
6. Teachers provide input to the Individualized Education Program (IEP) committee for handicapped students enrolled in industrial technology/technology education. ∇ 0 Δ
7. Both teacher-centered and student-centered instructional methods are utilized, as necessary. ∇ 0 Δ
8. Instructional methods reflect concepts and operating characteristics of systems and sub-systems, as necessary. ∇ 0 Δ
9. Instructional methods include both group and individual student learning activities, as needed. ∇ 0 Δ
10. Instructional methods promote the development of process skills such as creative and critical thinking, decision-making and problem-solving. ∇ 0 Δ
11. Instructional methods utilized are based upon individual student needs rather than upon the sex of the students. ∇ 0 Δ
12. Instructional methods enhance opportunities for multi- disciplinary learning. ∇ 0 Δ
13. Local program student club or TSA chapter activities are integrated into planned courses of study and are utilized in conducting classroom and laboratory activities. ∇ 0 Δ
14. Instructional strategies appropriate for serving students with special needs have been identified and incorporated, as needed, into the industrial technology/technology education program. ∇ 0 Δ
15. Student achievement is measured through a variety of testing techniques and other evaluation methods. ∇ 0 Δ
16. Each identified handicapped student enrolled in industrial technology/industrial technology education is evaluated annually through procedures and criteria described in the Individualized Education Program (IEP). ∇ 0 Δ
17. Student leadership skills are developed through a variety of curricular and extracurricular activities. ∇ 0 Δ
18. Student achievement is assessed to make systematic decisions regarding the effectiveness of instructional materials and teaching strategies. ∇ 0 Δ
19. Provisions are made for student input into the evaluation of instructional strategies. ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): — — —

4. Meeting Individual and Special Needs

All students have individual differences and special learning needs. Traditionally, however, discussions related to special needs have centered on students with disabilities , but students with other individual differences must also be considered. Provision must be made for: educationally disadvantaged, economically disadvantaged, limited English proficiency (LEP), gifted students and those with diverse cultural backgrounds. Additionally, students' preferred learning modes must be considered when planning instruction. Some students simply learn more, more efficiently, and more effectively when presented information in visual, auditory and kinesthetic means. Educational methods and procedures, instructional programs and materials, and school facilities must be modified for the purpose of individualizing programs and instruction to ensure that all students will develop to their fullest potential.

Federal legislation and teacher concern has provided the impetus to modify existing educational practices for learners with special needs. Such legislation is reflected in Public Law 94-142, the Education for All Handicapped Children Act of 1975 and its subsequent amendments, the Vocational Educational Amendments of 1976, sections 503 and 504 of the Rehabilitation Act of 1973, and more recently, the Carl D. Perkins Vocational and Applied Technology Education Act of 1990 (P.L. 101-392) and Public Laws 98-199, 94-198, and 101-476. The latter, the Americans with Disabilities Act of 1990 extends protection to adults. All of these laws emphasize the need to identify and infuse educational strategies designed to provide viable educational programs for special needs students. Furthermore, the legislation requires public education to provide instructional programs which will be the least restrictive educational alternative for students with disabilities.

Identifying Special Needs Learners

Industrial technology education professionals typically need not be concerned with detailed identification procedures for special needs learners, because they are the responsibility of other members of the education team. However, ITE/TE professionals should become familiar with some general characteristics of learners who are identified as "special needs" in order to better plan appropriate educational learning experiences and to contribute to the identification process when needed.

> **Educational methods and procedures, instructional programs and materials, and school facilities must be modified for the purpose of individualizing programs and instruction to ensure that all students will develop to their fullest potential.**

It should be recognized that the term "special needs" is an inclusive term which describes students with characteristics which may impede their ability to develop their maximum potential in unmodified programs. A broad understanding of the unique learning characteristics of students with disabilities, disadvantaged, limited English proficiency, or gifted/talented will be helpful to ITE/TE professionals in modifying programs to accommodate students with special needs. The following material lists and describes characteristics pertaining to special learning needs.

Learner Characteristics

Disadvantaged

Disadvantaged students have academic or economic disadvantages which impair their ability to function in regularly structured school programs. These students typically may be members of families with low incomes, low or underachievers, from culturally restricted backgrounds or with limited English proficiency (e.g. unfamiliar with American customs or the English language). Generally disadvantaged students are of normal or above intelligence but they fail to achieve in the regular school.

Academically disadvantaged students often display language difficulties, reading or writing problems, severe computational difficulties, or other general learning problems. These students may be frequently absent from school, have a short attention span and display low motivation when in class. They are often self-conscious, easily discouraged, have low self-esteem and express feelings of isolation.

Economically disadvantaged students typically are members of families whose incomes are below the national poverty level, have parents who are unemployed or are recipients of public assistance. Generally, these students exhibit many of the same behaviors as academically disadvantaged students.

Limited English Proficiency (LEP)

Limited English Proficiency means individuals who were not born in the United States or whose native language is other than English; who come from environments where a language other than English is dominant; who are American Indian and Alaskan native students and who come from environments where a language other than English has had a significant impact on their level of English language proficiency; and who by reasons thereof, have sufficient difficulty speaking, reading, writing or understanding the English language to deny such individuals the opportunity to learn successfully in classrooms where the language of instruction is English or to participate fully in our society.

Gifted and Talented

Gifted and talented students are those who, by virtue of outstanding abilities are capable of exceptionally high performance academically, physically, or creatively. However, these students will not live up to their full potential unless a challenging instructional environment is provided. The gifted also have unique needs and, as a result, they require enriched and challenging activities guided by a caring and stimulating teacher. In fact, unless they are challenged, these students' talent and creativity may turn toward disruptive behavior. Teachers should not assume that gifted children will be able to take care of themselves because of their superior intelligence.

Students with disabilities

Students with disabilities are learners who have specific or general disabling conditions that may interfere with their functioning in a regular school environment. These disabilities may be sensory, physical, emotional, or any combination of the three. There are several terms used to classify students with disabilities. Among these are the mentally retarded, hearing impaired, speech impaired, visually impaired, seriously emotionally disturbed, orthopedically impaired, other health impaired, deaf-blind, multi-disabled and learning disabled. Because of these impairments, students with disabilities may need special education and related services.

ITE/TE professionals will most often be providing educational experiences for those students who fit the category of "high-incidence" disabilities (i.e., those who comprise approximately 80% of the total population of students with disabilities). Among these students are students with learning disabilities, mildly retardation, speech impairments, and mild- to moderate-hearing or visually impairments. These students have been able to achieve success in the regular school environment when provided with supportive services and modifications in educational curriculum and teaching strategies.

Occasionally "low incidence" children with disabilities may also be placed in regular ITE/TE programs. However, most will be placed in self-contained situations such as community-based instruction, supported employment, and specially designed vocational programs where their needs are more appropriately met. Among the students who fall into this category are those with severe and profound retardation and severe emotional disturbance. Individuals with profound deafness or blindness and orthopedic disabilities also fall into the low incidence category. However, because of their general learning potential some have been able to function successfully in regular access/barrier-free school programs.

The placement of low incidence learners in a least restrictive environment must be determined through an extensive evaluation conducted by qualified specialists.

ITE/TE educators should be involved in the evaluation procedure, particularly to help ascertain a student's potential to function in an ITE/TE learning environment, and the subsequent development of appropriate portions of the individualized educational plan (IEP).

Generally these special needs students will require support services in addition to an access/barrier-free building. Examples of such support include: interpreters, educational tutors/aides and adaptive production jigs or fixtures.

The following provide a brief description of various disabilities. While not a totally inclusive listing, these characterizations will facilitate a better understanding for ITE/TE professionals of the general, physical, intellectual and social characteristics of students with disabilities.

- Individuals with "mild-moderate" mental retardation are those students who are capable of academic, social and vocational training, but who require specialized instruction to realize maximum skill development and meaningful integration into adult society.
- Individuals with "severe" mental retardation are those students who have potential for training in self-care, social adjustment, and vocationally-related areas rather than academic ones. During adulthood they may function effectively at home and/or in specialized situations such as supported employment and supervised living environments.
- Individuals with "profound" mental retardation are those students who are retarded to the extent that they are capable of very little self-care and often must have constant attention to survive.
- Students with learning disabilities have normal or above average intelligence but exhibit a specific learning disorder in one or more basic processes involved in understanding or using spoken or written language. Their learning problems are not due to visual, hearing, motor or environmental difficulties. Typical disorders which may be the cause of a learning disability are perceptual dysfunctions, brain injury, minimal brain dysfunction, dyslexia and developmental aphasia.
- Students with severe emotional disturbance or severe behavioral disorders exhibit undesirable behaviors or feelings over a long period of time that adversely affects educational performance. Students in this category have an inability to learn which cannot be explained by intellectual, social or health factors. School-related characteristics may include poor interpersonal relationships with peers and teachers; a general pervasive mood of unhappiness or depression; periods of self-stimulation or withdrawal; and a tendency to develop physical symptoms or fears associated with personal or school problems. The term includes schizophrenic individuals, most of whom may profit substantially from instruction as determined through comprehensive and specialized evaluation.
- Students with visual impairments are handicapped in a normal educational program by their difficulty or inability to see. Under this heading, students are classified as partially sighted, legally blind or profoundly blind. However, many have demonstrated the ability to develop proficiency in using ITE/TE equipment with some modification of the learning environment.
- Students with partial sight or legal blindness are those who can learn to read print, but whose vision is limited (even with corrective devices), and who need instructional modifications in order to succeed in a regular educational program. Partially sighted persons have a vision of 20/70 to 20/200 after correction with lenses. Legally blind persons have less than 20/200 vision with glasses.
- Individuals with profound blindness have the most severe visual impairment. They cannot tell light from darkness and as a result, cannot see print. Often they can benefit from instruction in braille. These students must depend totally on their other senses to function satisfactorily in an educational program.

- Students with orthopedic disabilities are normally limited in mobility, sitting and/or the use of tools and equipment because of muscular, skeletal or neuromuscular impairment. Included in the related causes of orthopedic handicaps are cerebral palsy, spina bifida, curvature of the spine, muscular dystrophy, hemophilia or other defects in legs, arms, neck or hips. Orthopedically handicapped students are generally average or above average in intelligence and can function in a regular school environment which has been adapted and made barrier/access free.
- Students with hearing impairments have a loss of hearing which affects their performance in a regular educational setting. Their sense of hearing is limited in many ways. For example, if students cannot hear the ordinary sounds of activity around them, then they are considered deaf. However, when students can hear, but only hear part of what is said, then they are considered hard-of-hearing. Hearing losses may be mild, moderate, severe or profound.
- Individuals who are hard of hearing have some ability to hear and understand the spoken word. Although some words may be audible, the pitch and frequency of these sounds may make it difficult for these individuals to ascertain their meaning. Sounds are not necessarily just softer to these individuals but may also be garbled and distorted. Some hard-of-hearing students may require the use of hearing aids and/or rely on lip reading. Likewise, deaf individuals must always require the use of an interpreter and/or lip reading.
- Students with speech impairments normally have speech patterns which are noticeably different from the norm. There are many forms of speech impairment, ranging from complete inability to speak to minor articulatory deficits. Furthermore, there are many causes for speech difficulties, ranging from delayed speech and hearing impairments to cerebral palsy and cleft palate.
- Students with other health-impairment are so categorized because they demonstrate limited strength, vitality and alertness. The conditions of these students are caused by chronic health problems such as heart conditions, tuberculosis, rheumatic fever, nephritis, hepatitis, asthma, epilepsy, leukemia or diabetes.
- Students with multiple disabilities exhibit combinations of two or more of the previously mentioned disabilities. For example, a student may be deaf and blind or orthopedically disabled and mildly retarded. As a result, special accommodations are necessary to facilitate their educational development.

Accommodating Special Needs Students in the ITE/TE Program

Educational methods and procedures, instructional programs and materials and school facilities must be modified for the purpose of tailoring instruction to serve special needs students in ITE/TE programs. The teacher cannot accomplish this task alone. Other professionals from such areas as special education, rehabilitation, school psychology, guidance and the community in general can help. Through cooperative efforts ITE/TE programs can effectively incorporate the fundamental elements for success and therefore be as appropriate for special needs learners as they are for other students.

The teacher remains the central factor governing the special needs student's potential for success in ITE/TE. The teacher's attitude, personality and self-concept will help govern his/her performance. Teaching students from special needs populations is very much like working with non-special needs students. Each needs empathy, guidance/direction, understanding and an appropriate and challenging learning environment carefully managed by a knowledgeable teacher. There are however, some subtle, as well as obvious, characteristics of certain learners that require a change of teaching style. For example, teachers who tend to "kid" or "tease" their students may find that students with poor self-image or low self-esteem may interpret this as "ridicule," "cruel," and "inappropriate punishment". Likewise, special needs students want "empathy" — understanding of their limitations and the desire to help remediate them (and also build upon strengths) — rather than "sympathy." Teachers must continue to be firm but fair, consistent and yet flexible, and concerned and caring enough to challenge special needs students to achieve new goals and experiences.

To help provide such an environment, many useful items, for both instructor and student, are available from the Special Education Dissemination Center (SEDC). Although not exclusively concerned with ITE/TE resources, the center distributes and loans many items with direct value to our field. Contact them directly for their lending catalog, a description of services, their conferences and to be certain that your district is on their mailing lists:

Missouri Linc (314) 882-2733, (800) 392-0533
and in Missouri only
Special Education Dissemination Center (314) 882-3594
both at (800) 397-7340
401 E. Stewart Road
University of Missouri-Columbia
Columbia, MO 65211

Technology Center for Special Education (800) 872-7066
Rm. 24, School of Education
University of Missouri-Kansas City
5100 Rockhill Road
Kansas City, MO 64110

Much additional information and help is available from the profession's many special needs resources and guides. The ITE/TE instructor with a need to better serve special needs students is advised to secure some of the many guides listed in this Chapter's resource section (part 9).

5. Providing for Equity

When discussing equity it is important to remember that the term encompasses more than just sex fairness. It means being fair and impartial to people regardless of their sex, race, age and/or religion. Most materials that have been published recently have been revised to be sex fair. Additionally many references to aid the ITE/TE teacher in evaluating materials and practices on the basis of sex bias have been developed. Furthermore, most of these materials can be adapted to other equity targets if their terms related to sex fairness are replaced with others related to race, religion or age.

To insure quality programming, ITE/TE instructors should review all curriculum materials to eliminate biases. Of course, elimination of biased language will not eliminate biased conduct, but as the language is liberated from biased usage and assumptions, people will begin to share more equitably in social and economic realms.

The new thrust towards equity emphasizes action, not only in recruitment but also retention. ITE/TE instructors are therefore encouraged to assess why target group students do not return to the program if they leave. Additional assistance with equity thrusts may be obtained from:

Director
Special Vocational Services
Vocational Adult Education
Department of Elementary and
Secondary Education
P.O. Box 480
Jefferson City, MO 65102
(314) 751-2661

Sex Equity Coordinator
Project SERVE
8 London Hall
Instructional Materials Laboratory
University of Missouri-Columbia
Columbia, MO 65211
(800) 392-7217

Similarly, recruitment and program admission policies and procedures must be evaluated in order to eliminate any unnecessarily restrictive statements. Poorly phrased or overly restrictive policies could bias class participation in unintended ways. Course prerequisites, if any, must be examined in the same way to determine if they are unnecessarily restrictive or are inadvertently prejudiced.

Change is a slow process and traditions are not relinquished easily. Technology Education/Industrial technology educators must examine their own beliefs and assess their appropriateness. If they are dedicated to quality education for all students, ITE/TE teachers must remove those barriers which prohibit equity for all potential students. Though industrial technology/technology education has been an integral part of the school curriculum for more than three-quarters of a century, there are students, parents and school personnel who may not be aware of this fascinating and important area of the curriculum and its potential for non-traditional students.

Efforts to bring about a better understanding of ITE/TE will help everyone appreciate its benefits for all students. Commitment for reaching all students involves some concrete action such as examining attitudes and behaviors, carefully choosing instructional materials and making conscious efforts to help people outside the classroom become aware of the accomplishments made by Industrial Technology/Technology Education. Figure VI-6 shows some of the strategies that will help in working towards increased equity.

Figure VI-6

Equity Strategies for Classroom Teachers[1]

1. Be direct with students about bias. Point out racist or sexist bias in books or materials. Help them learn to identify sources of bias and important omissions in the materials.
2. Develop classroom activities around identifying bias found in television, textbooks, movies, library books or magazines.
3. Incorporate the development of critical reading skills as an instructional objective for all your teaching, not just when special efforts are being made to identify bias in materials.
4. Identify or develop supplementary materials which can help "correct" some of the bias of available materials.
5. Assign student papers, themes, term papers or other activities on topics or persons not usually covered in textbooks or materials.
6. Invite local resource persons into your classroom to provide additional information and work with students on special projects and activities.
7. Ask students to rewrite materials or write their own materials on subjects omitted from the textbook or write the material from another person's point of view.
8. Use bulletin boards, posters, pictures, magazines and other materials to expose students to information commonly excluded from traditional materials.
9. Develop a classroom collection of non-racist, non-sexist reading materials for students. Identify books that students may be encouraged to seek out in their personal reading.
10. Be proactive in recruitment of nontraditional students and organize informational activities designed to attract nontraditional students.
11. Create an industrial technology education day where students in 6th or 7th grade can have hands-on experiences with technology.
12. Develop a slide-tape presentation targeted on non-traditional populations to encourage their participation in ITE/TE.

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[1] Adapted from *Guidelines for the Creative Use of Biased Materials in a Non-Biased Way.*

6. Evaluating Student Performance

ITE/TE instructors are routinely expected to assess and document student progress towards their (and the program's) competency goals. Clearly student evaluation is an integral part of teaching and with the implementation of instructional management systems it becomes even more important. Instructors should be careful not to allow themselves to consider evaluation as an intrusion, as something that takes away from instruction/learning time. Indeed, when properly handled, student evaluation will maximize the effectiveness of their instruction. To implement a systematic and effective evaluation scheme instructors should note that:

When properly handled, student evaluation will maximize the effectiveness of their instruction.

- Evaluation involves the assessing of each student's progress towards documented course and individual goals and objectives (such as the mastery of certain competencies).
- Feedback should be provided on a timely basis and in a constructive manner so as to encourage desired action.
- Self-evaluation by the student is an essential part of the overall evaluation.
- Each domain of behavior should be assessed by the evaluation system. Avoid one-dimensional evaluation (e.g., only knowledge or only psychomotor skills).
- There is a difference between evaluation and grading. The former ascertains the student's level of performance—the latter applies judgments to these assessments and links them to the system's grading scale.
- At the junior high levels, considering the developmental stage of the students, those who make an effort but fall short should not be failed merely because a lack of knowledge, skills, or attitude. At the same time, students should receive average or above average grades only for documented accomplishment.

Purposes for Student Evaluation

Two major purposes guide teacher evaluation of student performance. They are typically called formative and summative evaluation

- Formative evaluation is intended to have a shaping, guiding or other similar influence on students. It is administered before and/or during the learning process and as such it serves to give students feedback as to how they are doing. It is usually considered to be less threatening than other forms of evaluation. Often it is self-administered by the student and may not even need to be revealed to the instructor—depending on the maturity level of the student.
- Summative evaluation occurs at the end of some learning episode. This could be after a lesson, a major unit, a semester or a course. The purpose of this type of evaluation is to document how much and/or how well a student has mastered the target competencies at that given point in time.

  Typically summative tests are administered at the end of each major unit of instruction and at the end of each course. Such tests must systematically sample the target objectives/competencies that were taught in that unit or course. This is best accomplished by developing a table of specifications that matrixes objectives to test questions and levels of behavior. The results of such tests would then be recorded on progress charts, in grade books and/or in an instructional management system. This then yields a competency profile valid up to the date of testing.

Pretesting

Often instructors will wish to pretest their students prior to the beginning of a course or major unit. This is a highly recommended practice because it can tell them whether students:

- Have the prerequisite competencies necessary for success in the unit or course that is about to begin.
- Have mastered some or all of the competencies the unit or course is designed to develop.

The first readout can help the instructor identify and secure remedial help for deficient students. This can be used to bring weak students up to speed rather than slowing the entire class to accommodate their weakest member. The second readout would alert the instructor to allow advanced students to move at their own pace and reduce their likelihood of getting bored, disillusioned and/or disruptive.

Evaluation Techniques

Just as in teaching, the richer the variety of methods used for evaluation, the richer the learning experience will be for the students. Effective ITE/TE instructors will employ a wide range of such techniques in addition to the standard observation, oral questioning and informal evaluation. Some of the more formal approaches include:

Module-based Testing

In programs using TAMs and other modules, instructors need to develop individualized evaluation systems that can be administered with a minimum of demand on teacher time for administration and grading. Typically this results in the use of a combination of student self-assessment using product or process checklists, computer-based/scored testing, module progress/summary forms (a sample is shown in Figure VI-7) and peer assessment. Often additional combinations of the following evaluation methods are employed.

> **Just as in teaching, the richer the variety of methods used for evaluation, the richer the learning experience will be for the students.**

Figure VI-7

Sample Module-based Progress/Summary Form

Telecommunications Module
Student Progress/Summary

Student name: ____________ Class: ________ Period: ___

					Overall Points
____	**Day 1-2**				____________
____	1. Read pages 2-17 in...				
____	2. Answer 1st evaluation sheet	self grade	____	of 20 points	
____	3. Read pages 3-13				
____	4. Answer 2nd evaluation sheet	self grade	____	of 30 points	
____	**Day 3-4**				____________
____	1. Conduct activity one, laser communication				
	2. Chalk the experiment				
____	3. Collect experiment data	instructor rating	____	of 50 points	
____	3. Read pages 5-12				
____	4. Answer 1st evaluation sheet	self grade	____	of 20 points	
____	**Day 5-6**				____________
____	1. Watch telecommunication video				
____	2. Answer questions on worksheet 1	self grade	____	of 20 points	
____	3. Collect experiment data	instructor grade	____	of 50 points	
____	4. Read pages 5-12				
____	5. Answer 1st evaluation sheet	self grade	____	of 20 points	
____	6. Answer textbook assignment	peer grade	____	of 20 points	
____	**Day 7-10**				____________
____	1. Choose and read article in *Popular Mechanics*				
____	2. Write a 1-page report				
____	3. Word process your report	instructor grade	____	of 75 points	
____	4. Perform experiment 2				
____	5. Answer 1st evaluation sheet	self grade	____	of 20 points	
____	6. Take module post-test	instructor grade	____	of 75 points	

Total points earned by module activity ____________

Grading scale: A = 340+ B = 340-281 C = 280-191 D = 190-101 F = < 100

Progress Charts

These serve as a visible reminder to all students of their progress. If posted openly, it also shows how they compare to their classmates—a situation that has to be carefully monitored because of privacy issues. Progress charts can easily be used to track mastery of competencies in each domain although they tend to be used more frequently with skill or job accomplishment.

Self- or Progress Checks

Especially when assigning more complicated and lengthy activities, it is desirable to encourage students to assess their own progress along the way. This is a lot better than having students find themselves short of the goal at the end of a long work period. Typically such progress checks are checklists of critical events or applicable criteria stated with enough detail and clarity that the student can assess his/her accomplishment of each step.

Rating Scales

Most often used to evaluate a finished project, activity or attitude, these scales can be completed by either the student, his/her peers or by the instructor. Typically such a scale evaluates the work, according to established standards on a scale of 1 - 5. A sample is shown in Figure VI-8. Because of the standardizing effect such scales have, they help increase the instructor's objectivity across pupils and students. Additionally, if given to students in advance as is suggested, such scales help them learn and clarify what is expected of them. This is particularly important for affective performance measures. Figure VI-9, an example from Missouri's *Introduction to Vocational Education Instructional Management* manual, provides an excellent format for documenting attitude measures. Such scales can also identify the weight placed on such criteria as:

- Accuracy and precision
- Craftsmanship
- Degree of complexity/difficulty
- Work habits
- And many others.
- Finish
- General design
- Time used
- Originality

Achievement Tests

Sometimes these are considered appropriate only for the cognitive domain (i.e., what students know) but this is a mistake. Properly constructed performance tests are also excellent for validating mastery of sensori-motor competencies.

Instructors should be careful to evaluate only against the clearly stated goals/objectives of a course, major unit or lesson.

Instructors should be careful to evaluate only against the clearly stated goals/objectives of a course, major unit or lesson. Such tests need to be developed to measure the appropriate level of performance in each domain. The most systematic manner to insure this is to use a table of specifications that indicates how many questions, and which levels, will be used to assess each objective.

Good tests must be valid and reliable. Validity is simply that a test measures what it is supposed to measure and not something else. Reliability is the characteristic that insures the results are the same each time people with the same capability are evaluated. Also, good tests must necessarily discriminate between students who have mastered the desired competencies and those who have not. Effective tests are moderately difficult, they are systematically representative of the objectives and content, they are clearly objective in their assessment and they are reasonable in terms of their length (time). To be assured of quality, it is recommended that ITE/TE instructors systematically establish the reliability and validity of their tests.

Instructors are advised to keep an ongoing bank of test questions and that each question be coded to an objective and to where the answer may be found, e.g., textbook page. Another desirable practice is to submit major unit and course tests to an item analysis program. This gives the instructor an excellent insight into the quality of his/her test and thereby encourages refinement for the next time. With the increasing number of test-scoring machines in the schools, such programs are more easily available.

Oral Test/Questioning

Typically this kind of evaluation is one of the mainstays of ITE/TE. It works well to check on reading and other homework assignments and as a preliminary review for major written tests. To increase objectivity and systematic coverage, it is recommended that instructors develop the questions and an answer key in advance of the administration of an oral test. Similarly a form for recording responses helps utilization of the oral questionings results.

Figure VI-8

Sample Rating Scale

Course: ________________________________ Date: ____________

Lesson # ________ Title: ______________________________________

Student: ____

Performance Rating

TASK	Poor 1	2	3	4	Excellent 5
1. Clean copper soldering iron tip with file					
2. Plug from soldering iron					
3.					
4.					
5.					
6.					
7.					
8. Solder connections (proper amounts of heat and solder)					

Total Points: ______

Figure VI-9

Affective Performance Objective Format[1]

Given ____

____
(Specify setting where performance is to be demonstrated and any other conditions that may exist.)

The ______________________ student will:
(Specify program)

____
(Write in the affective performance expected)

____

This attitude (affective performance) will be judged "satisfactory" if the following criteria (indicators) are observed/measured by the evaluator:

The Student

Does	Doesn't
1. ______________	1. ______________
2. ______________	2. ______________
3. ______________	3. ______________
4. ______________	4. ______________
5. ______________	5. ______________
6. ______________	6. ______________
7. ______________	7. ______________
8. ______________	8. ______________

Improving Written Tests

Written tests can take many forms: true/false, multiple choice, matching, short answer and essay are among the most frequently used. The Texas *Industrial Technology Curriculum Guide* (p. 278-9) provides the following suggestions to improve the quality of evaluation:

---

[1] *Introduction to Vocational Instructional Management Systems.*

"Written tests should contain a sufficiently large number of the significant items selected from the content included in the course. They should include a variety of types of items each phrased in suitable vocabulary with an appropriate range of difficulty. Tests should be attractive and easy to read. Drawings and sketches may be used effectively in test items and they may help to make the test interesting to the student. Test directions should be brief, but definite. . . .

Items used on written tests generally fall into three categories: essay, recall and recognition. Multiple choice, true-false and matching items are of the recognition type while listing and completion items are of the recall type.

- The essay type of item requires that a student understand the subject matter thoroughly and express this knowledge in written form. When essay items are used, care should be taken that the topic is of major importance to the course. Since a considerable amount of time is required to write an essay answer, this type of examination usually involves a limited sampling of the total area of instruction. Subjective judgment is required in the scoring of essay type answers. However, a careful analysis of the material encompassed in the item and the preparation of a rating scale may help to make scoring of these items more objective. The instructor should be alert to the writing ability of the student when he/she uses essay tests.

- Recall items require the student to complete a statement, supply an answer to a question, or list certain items. The answer may involve simple facts or concepts that are of importance to the work, or may require the solution of a problem which applies these concepts. Scoring of items of this type requires reading the answers and applying judgment in cases where several different words could supply the same meaning. This task is easier if spaces for the answers are placed at the left of the page rather than in the text of the items. If separate answer sheets are used, they should be ruled or printed to provide uniform spacing for the answers.

- Recognition type test items require that the student select a response from a number of given possibilities. Properly constructed recognition type items provide a desirable means of objective testing, since the respondent must choose one correct or best answer. Recognition type items lend themselves well to the use of printed answer sheets, perforated scoring masks and computer scoring (added).

Students may guess right answers for recognition items; however, the effects of guessing are decreased as the number of items in a given test is increased. A true or false test should contain at least fifty items to reduce the effects of guessing. The guessing factor in multiple choice or matching items is less important if four or five plausible choices are provided."

Grading

After evaluation mechanisms are employed, ITE/TE instructors face the challenge of converting these results into a grade. This is typically a difficult task because it involves a considerable amount of professional judgment. Here the instructor must be careful to be:

- Fair to students regardless of their personal feelings.
- Consistent from class to class.
- Systematic in assessing all desired dimensions of performance.
- Accurate to avoid mistakes.
- Free from bias of any kind.

One of the best ways to meet such high criteria is to carefully document the evaluation criteria and grading system. When looking at a system on paper, the errors and weak assumptions just seem to "jump out" at you. A sample of a systematic procedure is provided in Figure VI-10 An instructor would use this by:

1. Identifying each of the major evaluative criteria in columns across the top of the table. In this example, columns 2, 3 and 4 show that written tests, performance tests and behavior traits are all being judged.
2. Indicating the weight placed on each performance dimension in columns across the top of the table. In this example columns 5, 6 and 7 respectively show weights of 30%, 50% and 20%.
3. Providing columns (#'s 8, 9, and 10) for total points earned and the corresponding letter grade.
4. Listing students' names in column 1.
5. Indicating the maximum number of possible points that a student can earn in each performance domain along the bottom row of each column. In this example note that students can earn a maximum of 150 points as the sum of all written test scores, a maximum of 150 points as the sum of all performance test rating scales and a maximum of 50 points on the behavior traits (attitude and behavior) ratings.
6. Entering each student's total points in each performance domain column (#'s 2, 3 and 4).
7. Working out the weighted points earned for each performance domain by using the formula as shown. Record the result in the appropriate WPE column (e.g. 5, 6 or 7).
8. Adding points in columns 5 + 6 + 7 and recording the sum in column 8.
9. Listing scores in order from high to low in the distribution column. Use your judgment to draw the breaks/division lines that separate A from B from C, D and F performance. In the example shown, the instructor had very high standards. If the material was well covered, remediation and sufficient time provided such standards may be appropriate. Enter the letter grades in column 10.

Figure VI-10

Simulated Record of Scores and Grading System

Grading Period ____________ Instructor ____________ Course ____________

	Sum of Points Earned			Weighted Points Earned					
Row/Column Student	Written Eval 2 ΣWr	Perf. Eval 3 ΣPe	Behavioral Eval 4 ΣTr	Written 5 30%Wr	Perf. 6 50%Pe	Behavioral 7 20%Tr	**Total Points Earned** 8 of 100%	Distribution column-List scores in order from High to Low 9 ΣPoints	10 Grade
1	139	144	39	28	48	16	92	92	A
2	123	135	45	25	45	18	88	92	A
3	126	130	40	25	44	16	85	91	A
4	121	123	39	24	41	16	81	88	B
5	142	131	47	29	44	19	92	87	B
6	119	119	35	24	40	14	78	85	C
7	119	119	38	24	40	15	79	85	C
8	92	95	32	18	32	13	63	81	C
9	119	108	35	24	36	14	74	79	C
10	116	109	37	23	37	15	75	78	D
11	106	104	36	21	35	14	70	75	D
12	126	135	43	25	45	17	87	74	D
13	132	141	45	26	47	18	91	71	D
14	123	130	40	25	44	16	85	70	D
15	110	104	34	22	35	17	71	63	F
16	97	92	30	20	31	12	63	63	F
Maximum Possible (T)	150	150	50	30	50	20	100		

Formula for columns 5, 6 & 7:

e.g., for student 1, the WPE for written performance (column 5) is:

Weighted Points Earned = (ΣWr or ΣPe or ΣTr/T) (100) x (p) = WPE

= (139/150) x (100) x (30%)
= 93 x (100) x (30%)
= (93) x (.30)
= 28 (Rounded)

Legend

T = Total points possible for the given performance domain
p = Weight given to the designated performance domain
ΣWr = Total points earned by student in written performance domain (column 2)
ΣPe = Total points earned by student in skill performance domain (column 3)
ΣTr = Total points earned by student in behavior performance domain (column 4)

7. *Incorporating Student Organization Activities*

Organized student association activity is typically less formal than the school and its atmosphere develops important individual and group interaction and social skills. Through interpersonal relationships and communication, each student contributes, either as a leader or follower, to group activities. ITE/TE club activities should be an integral part of this important socialization process. As essential elements in the educational experience, these activities naturally fall under the supervision of technology education/industrial technology educators.

At the national level the industrial technology/technology education youth organization is the Technology Students Association (TSA). The name of the student organization, that represents Industrial Technology/Technology Education in our state is the Missouri Technology Student Association and it is referred to as MoTSA. Both of these organizations offer a great deal of assistance in the operation of a local student organization and affiliation with both is strongly encouraged. Teachers should note, however, that affiliation is optional and many benefits can derive from independent student organization activities as well. Nevertheless, because of the many strong benefits of affiliation, it is encouraged. For example, state and national organizations provide student and advisory handbooks, activity guides, organizational recommendations, contest standards, and motivating audio-visuals.

Figure VI-11 highlights the goals and objectives of MoTSA. Activities should interface with the curriculum areas in the school. For example, research could be conducted in conjunction with the English department, experiments could be performed jointly with the physics, chemistry or mathematics departments. These examples are only intended to spark ideas about ways in which interaction can take place. There are virtually unlimited opportunities for these kinds of activities. For further information and specifics on the operation of a local MoTSA chapter contact (through Missouri's State Supervisor of Industrial Technology Education) the state organization for copies of their latest publication, *Missouri Industrial Technology Education Student Activities Guide* (Hart, 1987, revised).

Participation in the Missouri Industrial Technology Education Awards Program is a "sure-fire" way to encourage students to greater heights. There is something about competition that brings out the best in many. In recognizing this MoTSA advisors, i.e., teachers just like you, often establish competition among the chapters in the state. Additional information and guides are available from MITEA, UMC's Instructional Materials Laboratory and/or the State Supervisor of Industrial Technology Education. Existing and/or events under consideration include:

- Drafting contest
- Bridge/Structure building contest
- Electronic troubleshooting contest
- Programming contest
- Inventor's showcase
- Syringe robot competition
- Video commercial
- Mouse trap vehicle
- Payload glider
- Technology problem-solving
- Computer assisted design and drafting contest
- Manufacturing contest (e.g., mass production)
- Energy & power contest (e.g., mousetrap car, rockets, etc.)
- Metric 500 contest
- Design problem (e.g., egg drop)
- Computer simulation contest
- Robot challenge contest
- Rube Goldberg Engineering
- Bridge engineering
- Human tractor engineering
- Missouri 500
- Solar car engineering
- Technological literacy knowledge contest

Figure VI-11

Goals & Objectives of the Missouri Technology Students Association

Goals:

- To promote leadership, fellowship, and scholarship among students throughout the state of Missouri.
- To promote technology education/industrial technology education programs in the public schools of Missouri.
- To increase the knowledge and understanding of our industrial society and its relationship to technological advancement.

Objectives:

1. To develop through group action the ability of members to plan together, organize and carry out worthy activities and projects.
2. To provide good leisure time activities and hobbies.
3. To promote high standards of craftsmanship and safety.
4. To assist in providing guidance and counseling for students enrolled in technology education/industrial technology education programs in making informed and meaningful choices in selected occupational fields.
5. To prepare individuals for enrollment in advanced or highly skilled vocational and technical education programs.
6. To develop consumer knowledge.
7. To provide occupational information and instructions pertaining to a broad range of occupations.
8. To provide exploratory experiences in laboratories and observations in business or industry to acquaint students with jobs in the different occupations.
9. To assist technology education/industrial technology education students in creative expression.
10. To promote and encourage all students to utilize basic essential skills taken from the objectives of the BEST, CAT and Core Competencies Tests.

8. Developing Employability Skills

Employability skills refer to competencies possessed by individuals which allow them to get and keep a job. Occupational skills associated with specific jobs are not employability skills. Rather, what is being referred to are things such as dependability, punctuality and general work attitudes. Typically employability skills involve competencies in three primary areas: personal characteristics, job seeking techniques and entrepreneurship awareness.

Why should employability skills be of concern to ITE/TE teachers? There are several reasons. Many ITE/TE students will go on for further training in vocational education programs and the skills learned in ITE/TE will make it a great deal easier for them to succeed. Many students find work after high school and will be in need of these skills in order to keep their job. Some students work part time while going to school and employability skills make it possible. Still other students drop out of formal education and attempt to find work on a full time basis. Without these skills they are likely to be doomed to failure. Figure VI-12 lists a set of employability competencies in a format that provides ITE/TE instructors a convenient way to record mastery. The course and core competency lists provided in part 4 of Chapter X also include important employability skills.

There are three major components of employability skills education. Skills, needed to **get** a job, and skills necessary to **keep** a job are the first two. Both are equally important and neither should be overlooked. It stands to reason that in order to keep a job you must first get one. Conversely it does little good to get a job if you can't perform well enough to keep it. The third component, entrepreneurship awareness, represents job creation for oneself, rather than working for someone else.

> **Technological literacy together with a constructive attitude are the keys to employability skills and future opportunity.**

The first order of business for anyone looking for work should be the acquisition of job seeking skills. These are skills that allow individuals the opportunity for employment and to show how well they are able to perform on the job. Pertinent questions to ask when planning employability skills instruction are:

- How do you apply for a job over the phone?
- How do you answer a newspaper advertisement of a job?
- How do you interview for a job?
- What type of clothing should be worn to an interview?
- What information should be included in a resume?
- Are there any techniques that will make interviews easier?
- How is a job application form completed?
- Who and what are personal references?
- What should be done when offered more than one job?
- What criteria should be used to evaluate job offers?

Personal Characteristics

Directions:

Rate the student by checking the appropriate number on each scale. The ratings should be based on your observation of the student rather than on the grades given in class.

Rating Scale:
3 Above Average
2 Average
1 Below Average

Job Seeking Techniques

Directions:

Evaluate the student by checking the appropriate number or letter to indicate the degree of competence. The rating for each task should reflect employability readiness rather than the grades given in class.

Rating Scale:
3 Mastered
2 Requires Supervision
1 Not Mastered
N No Exposure

Entrepreneurship Awareness

Directions:

Evaluate the student by checking the appropriate number or letter to indicate the degree of competence. The rating for each task should reflect employability readiness rather than the grades given in class.

Rating Scale:
3 Mastered
2 Requires Supervision
1 Not Mastered
N No Exposure

---

3 2 1 **Personal Characteristics**

☐☐☐ 1. RELATIONS WITH OTHERS (effectiveness in working with students, instructors and others; cooperation; shows respect)

☐☐☐ 2. DEPENDABILITY (attendance; punctuality; adherence to schedules and deadlines; consistency and results; perserverence)

☐☐☐ 3. WORK ATTITUDES (willingness to learn; willingness to accept & profit from evaluation; enthusiasm; initiative; commitment; pride in work)

☐☐☐ 4. COMMUNICATION (listening; speaking and non-verbal skills; effectiveness in communicating with students, teachers and others)

☐☐☐ 5. PERSONAL HYGIENE & GROOMING (personal health care & cleanliness; dresses and maintains self appropriately)

OTHERS (specify):

☐☐☐ ____________________

☐☐☐ ____________________

3 2 1 N **Job Seeking Techniques**

☐☐☐☐ 1. Apply information about self and job opportunities in career decision making

☐☐☐☐ 2. Write a resume

☐☐☐☐ 3. Prepare a job application form

☐☐☐☐ 4. Write letters of application and acceptance

☐☐☐☐ 5. Arrange for personal references

☐☐☐☐ 6. Apply job search techniques

☐☐☐☐ 7. Arrange a job interview

☐☐☐☐ 8. Apply job interview techniques

☐☐☐☐ 9. Evaluate job offers (actual or simulated)

Others (specify):

☐☐☐☐ ____________________

☐☐☐☐ ____________________

☐☐☐☐ ____________________

3 2 1 N **Entrepreneurship Awareness**

☐☐☐☐ 1. Describe five characteristics of a free enterprise economic system (ownership of property, profit motive, risk taking, competition, supply & demand)

☐☐☐☐ 2. Name four forms of business ownership (sole proprietorship, partnership, corporation, cooperative)

☐☐☐☐ 3. Describe advantages and disadvantages of small business ownership.

☐☐☐☐ 4. Identify steps necessary to start a business (evaluate need, site selection, marketing plan, financial plan, management plan)

☐☐☐☐ 5. Identify business opportunities related to training

☐☐☐☐ 6. Identify personal traits of the entrepreneur (versatility, aspirations, energy, integrity, adaptability, etc.)

Others (specify):

☐☐☐☐ ____________________

☐☐☐☐ ____________________

Figure VI-12 Employability Competency Profile[1]

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[1] Instructional Materials Laboratory, University of Missouri-Columbia

Other than specific occupational skills, several personal qualities have been identified that employers expect and demand of employees. In the past these have, mistakenly, been referred to as personality traits. Personality traits are difficult, at best, to change. Employability skills on the other hand are learned and can be taught in a systematic, logical manner. Some of these competencies are:

- Punctuality
- Reliability
- Showing initiative
- Demonstrating respect for others
- Personal hygiene
- Ability and willingness to follow directions
- Ability to get along with co-workers
- Ability to be self directive and complete tasks unassisted
- Ability to communicate with others
- Ability to accept, and profit from, criticism
- Technological capabilities commensurate with the job
- Dependability
- Being cooperative
- Perseverance
- Willingness to learn

Increasingly, American industry has called for employees who possess what has varyingly been called: technological literacy, generalizable skills, transferable skills, etc. Research has identified seven key competency vectors that define the target. Figure VI-13 depicts these.

Figure VI-13

Seven Key Competency Vectors Detailing Technological Literacy

1. Teamwork & interpersonal skills/collaboration
2. Constructive work habits/values
3. Technological procedures
4. Technological capability
5. Basic functional skills
6. Thinking & decision-making skills
7. Ability to learn/adaptability/learning to learn

In the CTTE's 1991 Yearbook entitled *Technological Literacy*, a model (shown in figure VI-14) for this set of competencies was synthesized. Because it depicts relationships critical to ITE/TE's dual missions of general education and vocational foundation building, this model provides key directions for the profession. The model incorporated six key points:

1. Technological literacy builds on **a base of general education**.
2. Technological literacy includes as an integral **core** component, the mastery of a set **of generalizable technological skills** that focus on the process of interacting with technology.
3. Technological literacy must include a dimension of capability, i.e., **hands-on capability**, with technology.
4. Technological literacy is important because it empowers individuals to progress towards **goals of family, social, occupational, civic and consumer effectiveness** as they interface with technology.
5. Progress towards technological literacy is primarily attained by three mechanisms: systematic **education, maturation, and individual effort**.
6. Technological literacy exists as a continuum that enables people to possess it at **various levels** that, optimally, are commensurate with their job and developmental stage.

The synthesis of these features into a graphic model resulted in the visual analogy depicted in Figure VI-14. The model builds on a large disk (A), which represents the **foundation established by general education**. This component contains the basic functional skills, e.g., reading, writing, and calculation, that are needed to sustain all subsequent learning.

Upon the foundation established by general education is built an ever-increasing cone (B) of **technologically generalizable skills**, e.g., problem-solving, teamwork, interpersonal skill, constructive work habits, technology assessment and the interfacing of ethics and questions of appropriateness to technology. These encompass the processes of working with technology.

The generalizable skills cone itself houses additional cones (C) depicting **actual technological capability** in the basic subsystems (in this case three) of technology. Note that the names or number of such systems is not critical--as long as they encompass the totality of technology. Component B, the generalizable skills of technology, is to be considered as permeating throughout each of the cones of technological capability.

Individuals work to attain an **interacting set of goals** (D) depicted in the target disk. These goals are typically attained by a blend of at least three different, and sometimes complimentary forces (E) consisting of personal effort, systematic education and maturation.

Finally, **the key outcome**, i.e., the **development of ever increasing levels of technological literacy**, is depicted by the upwardly spiralling white arrow (F) around the technological procedures (B) and technological capability (C) cones.

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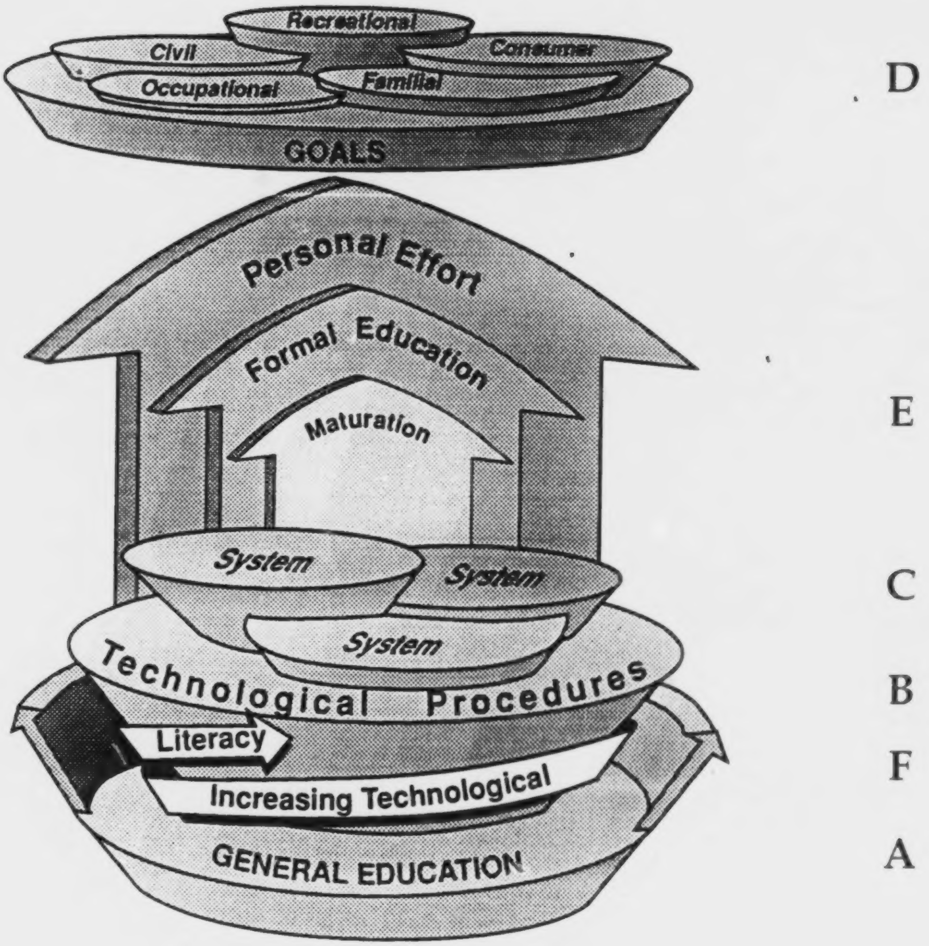
Figure VI-14

Technological Literacy[1]


Recreational
Civil
Consumer
Occupational
Familial
GOALS
D
Personal Effort
Formal Education
Maturation
E
System
System
System
C
Technological Procedures
B
Literacy
Increasing Technological
F
GENERAL EDUCATION
A

---

[1] Dyrenfurth (1991)

All components of the model, but particularly the general education (A), the technological procedures (B), and the technological capability (C) ones play major roles in developing critical thinking, decision-making skills and the ability and included of learning to learn.

In designing this model, the attempt was to use graphic implications to descriptively reinforce key characteristics of the concept of technological literacy. For example, cones are used to represent the increase in both breadth(scope) and depth that can result from enlightened effort over time. Similarly, an upward spiral is used to depict technological literacy's levels because of a spiral's never ending characteristic as well as its use as a metaphor for the systematic reinforcement and enhancement of previously learned capabilities. The parallel to the spiral curriculum advocated by Brunner and others is deliberate.

The cones representing technological capability are deliberately shown as intersecting to represent the interaction among technology's sub-systems. Similarly, the goals for which one seeks to develop technological literacy are depicted as interlinked. Also the entire technological domain of the model (components B & C) is shown truncated at its base to suggest that it begins somewhere within general education.

Another intent is to emphasize the dynamism of this model. For this reason, goal-oriented arrows are used to depict human effort/action, as is the spiral. In fact, the author also envisions the depicted components of technological literacy to represent **competency vectors** that have both a direction and a magnitude. Furthermore, these vectors can change their direction and dimension, as well as their composition. Given the ever-evolving nature of technology, it was mandatory that the technological literacy model be capable of accommodating change.

To summarize, this model demonstrates that in today's and tomorrow's ever more complex and technological world, technological literacy is a key element to achieve efficiency in personal (familial), social, civic and also occupational spheres of activity. By mustering the forces of personal effort, maturation and systematic education; technological literacy is achieved by mastering the key essentials of: The ways of interacting with technology (technological procedures); and technology's core capabilities within each of the primary subsystems of technology (e.g., energy & power, materials & processing, and communication). All of these, of course, build on a solid base of general education (basic functional skills). Teamwork, constructive work habits and critical thinking skills are reinforced by their technological applications. The synthesis of these capabilities results in increased capacity for "learning-to-learn". Then, as people advance, and as depicted by the model's upwardly spiraling ribbon, the requirements for technological literacy escalate as people assume positions with ever increasing responsibility.

Technological literacy, as presented in the preceding model, necessarily requires the mastery of a critically important set of core competencies. The overview of these was presented in Figure VI-13. However, more detail is needed if ITE/TE instructors are to systematically aim at this goal in concert with their students. The needed detail is presented in Figure VI-15.

Figure VI-15

Competencies detailing technological literacy's seven vectors

1. **Teamwork & interpersonal skills/collaboration**, using:
   - A. Interpersonal skills
   - B. Collaboration skills
   - C. Conflict resolution skills
   - D. Relational skills
   - E. Feedback mechanisms to leaders
   - F. Group production
   - G. Small group sessions
2. **Constructive work habits/values**, demonstrating:
   - A. Positive attitude
   - B. Motivation and commitment to joint goals
   - C. Self-direction
   - D. Willingness to assume responsibility
   - E. Comfort with technology
   - F. Maintenance of confidentiality
3. **Technological procedures**, for example:
   - A. Understanding the "big picture"
   - B. Applying systems theory, including:
   - C. Visualizing technology
   - D. Understanding unfamiliar technology
   - E. Operating human--machine interface systems
   - F. Planning, organizing & prioritizing
   - G. Processing/monitoring information
   - H. Interpreting process phenomena/system stability
   - I. Assessing technology
   - J. Employing technical networking
   - K. Diagnosing technical problem-solving
   - L. Reasoning technologically
   - M. Technological futuring
   - N. Using computers
   - O. Creating, innovating
   - P. Planning career and personal development
   - Q. Employing technological safety
4. **Technological capability**, demonstrating:
   - A. An awareness of, and capability with, basic operation/use of technological tools, materials and processes
   - B. An ability to follow technological procedure/instructions
   - C. Interpretation of schematics and drawings
   - D. The performance of systems maintenance and prevention tasks
   - E. Basic mastery of the technological core of information pertaining to Materials & processing
5. **Basic functional skills**, demonstrating:
   - A. Computation skills/technical calculations
   - B. Reading and comprehension
   - C. Scientific knowledge
   - D. Written/oral/visual communication
6. **Thinking & decision-making skills**, demonstrating:
   - A. Critical/higher order thinking skills
   - B. Decision making
   - C. Inference/statistical & logical
7. **Ability to learn/adaptability/learning to learn**

9. Resources

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McCrory, D. L., & Maughan, G. R. (N.D.). *Resources in technology.* Worcester, MA: Davis.

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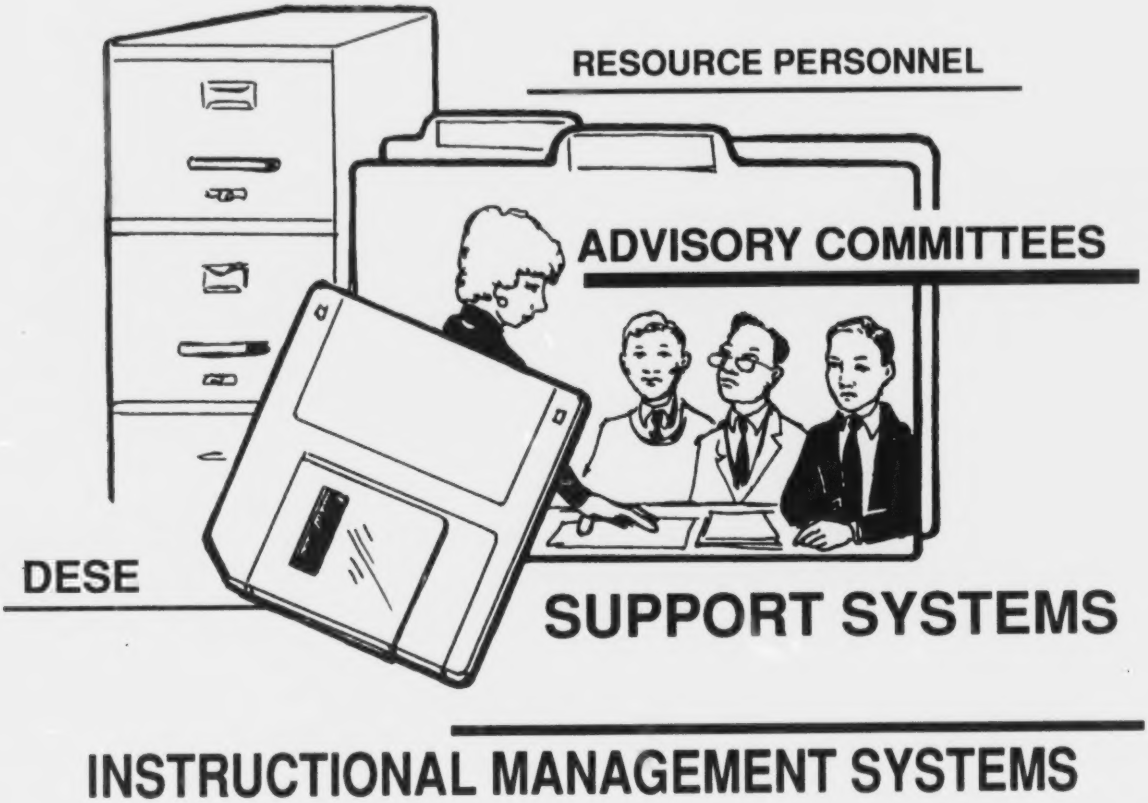
Chapter VII

Organizing & Managing the ITE/TE Program


RESOURCE PERSONNEL
ADVISORY COMMITTEES
DESE
SUPPORT SYSTEMS
INSTRUCTIONAL MANAGEMENT SYSTEMS

Chapter VII

Organizing and Managing the ITE/TE Program

1. Introduction & Overview

Overview

"Even the best laid plans can go astray!" To be sure, but when they do it is most often a problem with organization, management and follow-up. Typically the ITE/TE instructor's ideas are sound and well-founded—but, if and when problems arise, it is his/her action or follow-through that is lacking—and often not due to any personal failing but rather because of a lack of support. Consequently, this chapter's intent is to help ITE/TE instructors organize and manage programs more effectively. As such, this chapter shares the collective experience of the profession's best practitioners.

To this end, this chapter's main parts present guidelines to help find and make effective use of key resource people, to use available support systems, to use advisory committees to achieve the ITE/TE program's goals,and to organize and manage the program better. Properly organized and managed, these resources will help students achieve more—and with less strain on your part.

Objectives

1. To document the key resource personnel who contribute to improved ITE/TE programming.
2. To share suggestions for identifying and accessing systems and resources that enhance the teaching and effectiveness of ITE/TE.
3. To encourage the use of advisory councils to enrich input to, and improve the quality of, ITE/TE.
4. To present key suggestions for organizing and managing an ITE/TE program and laboratory.

Chapter 7 Outline

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3. Using Available Support Systems 10
4. Using Advisory Committees 16
5. Organizing & Managing ITE/TE ... 19
6. Resources 27

2. Accessing Key Resource Personnel

It is impossible for anyone to be all things to all people. This is especially true in the world of technology with its exponential rate of growth and change. Therefore the ITE/TE teacher must be aware of key resource personnel who are available to offer assistance. Typically nine categories of resource people are used most often.

- Local school and school system personnel

- Other local, state and national members of the profession
- University faculty
- Department of Elementary and Secondary Education (DESE) personnel
- Other Missouri state department/divisions in related areas, e.g., the Department of Health and Human Services, Economic Development and the like
- Educational association/staff members
- State and national special focus groups
- Individuals employed in technology (business & industry)
- Professionals in the community

Within the local school and system, several groups of resource personnel can provide a majority of the general assistance required. Quite naturally the first people to come to mind are supervisors, principals and superintendents. In addition, counselors, special education teachers, vocational resource educators and one's peer teachers are all excellent sources of assistance. Many of these are support personnel with the responsibility to assist the ITE/TE teacher to achieve his/her program goals and objectives.

DESE Personnel

The Missouri Department of Elementary and Secondary Education (DESE), also offers a great deal of assistance. It is important to note that its personnel's help is not limited to information on forms and finances. DESE staff have a wide range of contacts with other schools, both within the state and beyond it. Questions about what to teach, with what methods and how well these methods work are most appropriate for them to field as are questions about what is happening elsewhere.

State Department staff have a wide range of contacts with other schools, both in Missouri and in other states. Questions about what to teach, with what methods and how well these methods work are most appropriate for them to field as are questions about what is happening elsewhere.

Similarly, the state colleges, universities and the University of Missouri-Columbia (as listed in Figure VII-1) all provide excellent sources of information. Industrial education/industrial technology/technology personnel within these institutions have wide experiences with all types of technology and programs. Their faculty have diverse backgrounds, considerable professional involvement and they often conduct research in areas of special interest on a regular basis. They frequently offer seminars, courses, workshops and many types of in-service programs. However, don't wait until these opportunities present themselves. Call or meet with them to get your question answered. These faculty will be happy to assist you in solving a problem. If the problem is out of their area of expertise they will most certainly direct you to a more appropriate source of information and help. Figure VII-1 lists the names of colleges and universities in Missouri, along with department titles, addresses and phone numbers. Universities in other states are found in the *Industrial Teacher Education Directory*.

Business & Industry Personnel & Associations

Professional trade associations involved with any facet of any particular technology in question are other logical and important sources for help. These associations are found at local, state and national levels. Don't forget any of them. Much valuable assistance can be gotten from these sources. Figure VII-2 presents a sample of such organizations. ITE/TE instructors can identify additional appropriate associations by consulting the *Encyclopedia of Associations* or other association directories in the reference section at their nearest library.

Don't forget business and industry or the local community's professionals either. Frequently equipment, supplies and other materials are available just for the asking. Business and industry like to help education because the schools supply them with skilled manpower. Some of these contacts are, or should be, members of your advisory committee. Use these contacts regularly on both a formal and an informal basis. Show up at their places of business, just to be friendly, from time to time. Don't just show up or phone only when you want something. Offer your services when it is feasible for you to be of assistance to them and their firms. This type of partnership is one of sharing and cooperation and should be one of mutual benefit.

Figure VII-1

Missouri Universities with ITE/TE Programs[1]

Central Missouri State University
Warrensburg, MO 64093

- Department of Electronics Technology
  Phone (816) 429-4940
- Department of Graphics
  Phone (816) 429-4727
- Department of Manufacturing & Construction
  Phone (816) 429-4439
- Department of Power and Transportation
  Phone (816) 429-4975
- Department of Safety Science and Technology
  Phone (816) 429-4626
  Phone (314) 651-2104 or 2114

Northwest Missouri State University
Maryville, MO 64468-6001

- Department of Technology
  Phone (816) 562-1190

Southeast Missouri State University
One University Place
Cape Girardeau, MO 63701

- Dept. of Industrial Technology & Education
  Phone: (314) 651-2104

Southwest Missouri State University
901 S. National Avenue
Springfield, MO 65804

- Department of Industrial Technology
  Phone: (417) 836-5121

Lincoln University
Jefferson City, MO 65102-0029

- Department of Technology and Industrial Ed.
  Phone (314) 681-5482

The College of the Ozarks
Point Lookout, MO 65726

- Department of Technology
  Phone: (417) 334-6411

Northeast Missouri State University
Kirksville, MO 63501

- Division of Industrial Science
  Barnett Hall 120
  Phone (816) 785-4572

University of Missouri-Columbia
Columbia, MO 65211

- Industrial Education
  105 London Hall
  Phone (314) 882-2782

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[1] From *Industrial Teacher Education Directory*, 1990-91.

Figure VII-2

Selected Trade Associations Relevant to ITE/TE[1]

- American Foundrymans Society
- National Computer Graphics Association
- Graphic Arts Technical Foundation
- American Society for Testing and Materials
- Electronics Industry Association
- National Paint Council
- Society of Plastic Engineers
- American Society for Testing & Materials
- National Association of Manufacturers
- Western Woods Products Association
- Society of Manufacturing Engineers
- Screen Printing Association International
- American Petroleum Institute
- Association of General Contractors
- National Safety Council
- American Society for Metals
- American Welding Society
- National Association of Home Builders
- National Paint and Coatings Association

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[1] Addresses and descriptions are available in the *Encyclopedia of Associations.*

Government & Education Association Personnel

State and Federal government agencies in specific service areas can be of immeasurable assistance with problems in their area of expertise. Typically, the types of things that will be involved will not necessarily, be technological in nature, although, they may involve technology, either industrial, medical or some other kind. After all, technology pervades virtually every aspect of human endeavor. Some of the governmental agencies that can provide assistance are presented in Figure VII-3.

Educational associations on the local, state and national level can be of assistance in many ways. They offer publications, conferences and special-topic workshops and seminars. Membership in this type of association is highly recommended and it can pay off in dividends for students, faculty and the entire school district. Figure VII-4 lists some of the associations of relevance to ITE/TE.

Figure VII-3

Useful Federal and State Agencies

Federal

- The U.S. Department of Education
  400 Maryland Avenue, S.W.
  Washington, DC 20202
  Phone: (202) 732-2426

- National Center for Research in
  Vocational Education (NCRVE)
  1995 University Avenue, Suite 375
  Berkeley, CA 94704-1058
  Phone: (800) 762-4093 or (415) 642-3798

- National Center for Education & Employment
  The Ohio State University
  1960 Kenny Road
  Columbus, OH 43210
  Phone: (800) 848-4815

- Environmental Protection Agency
- Farmers Home Administration
- Nuclear Regulatory Commission
- The Dept. of Health and Human Services
- National Aeronautics & Space Administration
- Department of Transportation

State

- Missouri Vocational Resource Center
  (Includes Industrial Technology/TE)
  Room 10 London Hall
  University of Missouri-Columbia
  Columbia, MO 65211
  Phone: (314) 882-2883
  Toll Free: (800) 392-7217

- Missouri Occupational Information
  Coordinating Committee
  421 East Dunklin
  Jefferson City, MO 65101
  Phone: (314) 751-3800

- Missouri LINC
  609 Maryland
  University of Missouri-Columbia
  Columbia, MO 65211
  Phone: (314) 882-2733
  Toll Free: (800) 392-0533

- Missouri Council on Vocational Education
  P.O. Box 545
  Jefferson City, MO 65102
  Phone: (314) 751-4384

- Missouri State Agency for Surplus Property
  117 Riverside Drive
  P.O. Drawer 1310
  Jefferson City, MO 65102
  Phone: (314) 751-3415

- Division of Vocational Rehabilitation
- Division of Employment Security
- Division of Family Services
- Governor's Committee on the Employment of the Handicapped
- Job Development and Training Program
- Department of Health
- Departments Labor and Industrial Relations
- Wolfner Memorial Library (for the blind and physically handicapped)

The main two ITE/TE associations are the American Vocational Association's Technology Education Division and the International Technology Education Association. Both offer extensive benefits and programs of service to their members. In fact, many in the profession belong and actively participate in both. The Missouri Industrial Technology Education Association serves as the state's representative for both national associations. The Missouri Vocational Association, the state's AVA affiliate, has an Industrial Technology Education Division which provides programming and an interface to the vocational education system.

The International Technology Education Association (ITEA) and the AVA's Technology Education Division are the profession's voice for industrial technology/ technology education. Their purpose is to enhance service to youth. Their primary concerns involve the evolution of curriculum and personnel in the profession. Their programs for teachers, students and supervisors are based on the premise that technology/industrial technology education is vitally significant in a world where industry and technology are critical to every aspect of our life. Both state and national associations work to secure federal funding for industrial technology/ technology education programs and both have received recognition from the U.S. Department of Education.

The main two ITE/TE associations are the American Vocational Association's Technology Education Division and the International Technology Education Association. Both offer extensive benefits and programs of service to their members.

The Missouri Industrial Technology Education Association deserves special mention because it is our state's key professional association.

The Missouri Industrial Technology Education Association deserves special mention because it is our state's key professional association. Essentially the work of this association is conducted by an elected board of directors and by committees they appoint. The former is representative of the state's eleven regional ITE/TE associations. Some of the MITEA's main activities include:

- Issuing a regular newsletter/magazine
- Conducting the annual regional and state Industrial Technology Education Awards Program and Exposition for student skill and knowledge competition.
- Organizing professional development conferences several times each year (including the ITE/TE program at the Missouri Vocational Association's July conference.)

State and national special focus groups are associations of individuals with concern for specific groups of individuals. Among these groups are the handicapped, disadvantaged, blind, autistic and minority groups.

Quite frequently some of the best contacts and resources are parents and individuals currently employed within industry. These employees could be local or remote. They could also be personal friends or just casual acquaintances. It must not be forgotten that graduates from our own schools and programs make excellent resources as well. Ultimately, all of the association and group resources amount to individuals. Individuals are our contacts, allies and frequently our friends.

All of the above resources must be looked upon, not only as sources of information and possibly materials and supplies, but also as sources of speakers and demonstrators for our classes. Keeping up to date in all of industrial technology/technology's fields is virtually impossible. If, however, we use external resources to their fullest extent our students will gain an extremely diverse and well grounded education in technology.

Figure VII-4

Professional Associations Relevant to ITE/TE

International Technology Education Association (ITEA)*
1914 Association Drive
Reston, VA 22091-12502
Phone: (703) 860-2100

- Council on Technology Teacher Education
  ITEA-Council of Supervisors
- Council of Technology Education Associations
- Technology Education for Children Council

Technology Student Association (TSA)
1908 Association Drive
Reston, VA 22091-1502
Phone: (703) 620-1060

American Vocational Association (AVA)*
Technology Education Division*
1410 King Street
Alexandria, VA 22314
Phone: (703) 683-3111

Technology Education Collegiate Association
1914 Association Drive
Reston, VA 22091-1502
Phone: (703) 860-2100

Missouri Federation of Teachers (MFT)
8420 Delmar, Suite LL2
St. Louis, MO 63124
Phone: (314) 993-6122

Missouri State Teachers Association (MSTA)
407 South Sixth Street
P.O. Box 458
Columbia, MO 65205
Phone: (314) 442-3127; (800) 392-0532

Epsilon Pi Tau
Executive Secretary
School of Technology
Bowling Green State University
Phone: (419) 372-2425

Missouri National Education Assoc. (MNEA)
612 Eastland
Jefferson City, MO 65101
Phone: (314) 634-3202; (800) 392-0236

Missouri Congress of Parents and Teachers (PTA)
2101 Burlington
Columbia, MO 65201
Phone: (314) 474-8631

Missouri Vocational Association*
101 Madison
Jefferson City, MO 65101
Phone: (314) 634-7366

Missouri Industrial Technology Education Association* and its regional associations*

* Contact Missouri State Industrial Technology Education Supervisor for current president, address and phone.

Missouri DESE
P.O. Box 480
Jefferson City, MO 65102
Phone: (314) 751-7764
FAX: (314) 751-1179

School Administration

Perhaps no personnel are as pivotal to the success of the ITE/TE program as are the members of the school's administrative team. Here is where degrees of freedom are enlarged or restricted. Instructors must be certain to work carefully and systematically to build administrative support. The extent and nature of such support, as well as the challenge facing ITE/TE instructors can be determined using the MO ITE's Topic 5, Administration and Supervision Standards as shown in Figure VII-5.

Figure VII-5

MOITE Standards, Topic 5: Administration & Supervision Standards

Technology education and/or industrial technology education requires leadership from individuals who comprehend the philosophy and who demonstrate support by helping faculty and support groups to achieve stated goals and objectives. Like the faculty, the supervisor must also continue to grow professionally so that leadership represents the latest thinking in the profession. The statements contained within this standard topic concern the administration and supervision of a technology education program. Administrators and supervisors provide management of and direction for the program. These personnel perform leadership functions that ensure attainment of all program goals.

Fill in marks to indicate assessment: ∇ **not met,** 0 **met,** Δ **exceeded**

1. A minimum of one full-time local industrial technology/technology education supervisor is provided for 25 or more ITE/TE teachers, or for districts with less that 25 ITE/TE teachers, appropriate proportional supervision is provided. .... ∇ 0 Δ
2. Local supervisors are qualified ITE/TE teachers, have taught ITE/TE for a minimum of three years, and hold an appropriate master's degree. .... ∇ 0 Δ
3. Local supervisors conduct a minimum of one ITE/TE inservice program yearly. .... ∇ 0 Δ
4. A job description which includes the qualifications, duties, and responsibilities of each local ITE/TE supervisor is available. .... ∇ 0 Δ
5. In addition to local supervision, departmental leadership or management is provided. .... ∇ 0 Δ
6. A maximum of 20 students are enrolled per teacher, per period of laboratory activity. .... ∇ 0 Δ
7. A minimum of one non-teaching period for preparation is provided each day. .... ∇ 0 Δ
8. Time is provided to enable the industrial arts/technology teacher to organize and advise a local TSA chapter or local program student club. .... ∇ 0 Δ
9. Teacher aides or paraprofessionals are provided in classes where enrollment of students with special needs necessitates their assistance. .... ∇ 0 Δ
10. Supervisors and teachers utilize predetermined standards to plan and organize the ITE/TE program. .... ∇ 0 Δ
11. Supervisors and teachers utilize predetermined standards to develop short-and-long range program plans. .... ∇ 0 Δ
12. Provisions are made for teachers to review, develop, and adapt curriculum and instructional materials which are compatible with local and state ITE/TE guidelines. .... ∇ 0 Δ

Figure VII-5

MOITE Standards, Topic 5: Administration & Supervision Standards, continued

Fill in marks to indicate assessment: ∇ **not met**, 0 **met**, Δ **exceeded**

13. Supervisors and teachers cooperatively develop specifications for ITE/TE equipment and resource materials. .... ∇ 0 Δ

14. Supervisors involve teachers in developing specifications for ITE/TE facility design, development, and renovation. .... ∇ 0 Δ

15. Funds are made available for travel, release time, and substitutes for personnel to participate in inservice professional activities. .... ∇ 0 Δ

16. Funds are made available for travel, release time, and substitutes for personnel to participate in local, state, and national TSA or local program student club activities. .... ∇ 0 Δ

17. Written administrative policies and directives, specifically addressing the operation of the industrial arts/technology education program, are available. .... ∇ 0 Δ

18. Teachers are visited on a regularly scheduled basis by supervisory personnel. .... ∇ 0 Δ

19. Any reports required by local, state, and federal agencies are prepared and submitted on schedule .... ∇ 0 Δ

20. Accurate financial reports are prepared and submitted on schedule, as required. .... ∇ 0 Δ

21. Safety reports are prepared and submitted on schedule, as required .... ∇ 0 Δ

22. A biographic, academic, and medical profile is maintained on each student enrolled in ITE/TE .... ∇ 0 Δ

23. Demographic data about all technology/industrial arts students are available by grade level and by course, including but not limited to course enrollments by racial and ethnic categories, by sex, and by type and number of students with special needs. .... ∇ 0 Δ

24. Records and related information on equipment, tools, textbooks, and supplies are prepared and made available to appropriate personnel. .... ∇ 0 Δ

27. Effective, open communication pertaining to all elements in the instructional program is established and utilized consistently among ITE/TE faculty, school staff and administrators, school board members, supervisors, advisory committees. .... ∇ 0 Δ

28. Effective open communication pertaining to all elements in the instructional program is established and utilized consistently among ITE/TE faculty, and students and parents. .... ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): — — —

3. *Using Available Support Systems*

Available support systems are, as might be expected, closely related to the previous topic which highlighted resource people. Key resource personnel are a vital component of any support system. There are, however, some support systems that are not necessarily represented by individuals. Some of these include: state department of education programs, federal programs and physical plant services.

Missouri Department of Elementary and Secondary Education

The Missouri Department of Elementary and Secondary Education offers, on an annual basis, the Industrial Technology Education Grant Awards Program. Guidelines are issued yearly to help ITE/TE instructors apply for these funds. Typically they are earmarked for the improvement of instruction in Industrial Technology/ Technology Education programs. In the past, such funds have been available for exemplary programs, innovative teaching methods, equipment, supplies, copying and dissemination of successful practices. It is strongly recom-mended that ITE/TE instructors take advantage of this funding to supplement local resources. This enables a more rapid implementation of program change/ updating in order to better reflect industry and the rapidly changing technology it employs. Now, in addition to the grant awards programs, ITE/TE instructors have access to Missouri's Excellence in Education Act funds as well as to tuition reimbursement programs. Instructors may contact Missouri's Industrial Technology Education Supervisor or the office of DESE's commissioner for details on current funding possibilities.

It is strongly recommended that ITE/TE instructors take advantage of the ITE Grant Awards Program.

Federal programs of interest include the National Diffusion Network. This involves a linkage of centers that disseminate information about carefully evaluated and proven effective programs in all educational fields. Occupational Versatility, a multiple activity industrial exploration program, is one of the nationally disseminated models.

Special Needs Support

Other sections of this guide (in Chapter VI) have detailed much about the support services available from special needs specialists. Our state has an exceptionally effective network and support system for the disadvantaged, handicapped and minorities. The ITE/TE teacher must take the time to learn how this system's resources can be of most help to him/her in meeting the special needs of his/her students. Teacher aides, vocational resource educators, special instructional material, assistance with remediation and equipment modifications are but some of the resources that can be obtained.

Guidance Support

One of the support system crucial to the success of ITE/TE programs is the schools' guidance system. For maximum program effectiveness, formal and cooperative relationships are vitally important. Together teachers and counselors, with mutual concern for the students' development, can really accomplish significant goals. As a consultant the guidance counselor can work with the ITE/TE instructor in the area of student self- and career-awareness, showing the latter effective techniques and sharpening his/her observational skills so that he/she can facilitate group processes and individual conferences.

Computer Networking

You expected it didn't you? To use technology to help teach better that is. Well, recently several new computer networking, conferencing and messaging systems, such as Compuserve, FidoNet, and others, were established. With one of these, you can, at a reasonable cost:

- Join on-going discussion groups (electronically) about issues ranging from how to get more money budgeted for ITE/TE, effective public relations ideas and new legislation.
- Exchange information with colleagues, ask questions of them and of experts brought on-line for that purpose, offer opinions and suggestions—or just be an observer and read what other have entered.
- Participate when it is convenient for you; time and geography are irrelevant to computer conferencing. Go on-line at 3 a.m. or 3 p.m. and leave whenever you like—there are no schedules to be followed.
- Send and receive mail via computer; electronic mail allows you the same privacy and one-on-one communications you get using the U.S. Postal Service but without the delays!

There are also several excellent sources for public domain and/or shareware software for your computers—regardless of its brand. The best seem to be the various user groups that are found in most medium and larger-sized towns. One can usually learn about these from a store that handles your particular brand of computer. Through the ITEA's national office, one can also learn about various centers/people who are distributing ITE/TE software.

Accessing Audio-Visual Aids

ITE/TE teachers often find that audio visual aids really help to get the point across. But how does one find out where and what is available? Teachers are advised to keep scanning the professional magazines, e.g., *The Technology Teacher* (ITEA), *Vocational Education Journal* (AVA) and *School Shop/Tech Directions*. Most of these have special sections listing audio visual aids. Additionally, the trade (i.e., technical) magazines often list useful aids that can be acquired for little or nothing. Then there also publications like the *Educational Media Index, Index to Instructional Media Catalogs, NICSEM Index* for special needs materials and the *Free and Inexpensive Aids . . .* series, and the *Educator's Guide . . .* series that list useful materials. All are detailed in this chapter's resource section (part 6).

In Missouri and elsewhere, there also exist centers selling, and/or with lending libraries of useful films, videotapes and other aids. These include:

- UMC Film Library
  Academic Support Center
  505 East Stewart Road
  University of Missouri-Columbia
  Columbia, MO 65211
  (314) 882-3601
- Missouri Vocational Resource Center
  Instructional Materials Laboratory
  Room 10, London Hall
  University of Missouri-Columbia
  Columbia, MO 65211
  (314) 882-2883 (800) 392-7217
- Modern Talking Picture Service
  86 Weldon Parkway
  St. Louis, MO
  (314) 567-4278
- Media Center
  State Fair Community College
  1900 Clarendon Road
  Sedalia, MO 65301
  (816) 826-7100
- Agency for Instructional Television
  1111 W. 17th Street
  Bloomington, IN 47404
  800-457-4509

Securing Donations and Surplus

Several mechanisms exist whereby the ITE/TE instructor can secure donations or the equivalent. The easiest mechanism, although technically not a donation may be considered as one because of the very low cost charged for items. This is of course the State's surplus outlet in Jefferson City. This agency warehouses and makes accessible a wide variety of machines, tools, equipment and supplies of use to ITE/TE. It is worth a regular trip to see what they have—no phone call can communicate the variety of possibilities typically found there.

Instructors should contact the agency directly and process the necessary paperwork to document their eligibility. At the same time they should request to be placed on the mailing list for the agency's regular announcements. The address is:

Missouri State Agency for Surplus Property
P.O. Drawer 1310
117 Riverside Drive
Jefferson City, MO 65102
(314) 751-3415

The National Association for the Exchange of Industrial Resources (NAEIR) exists just for the purpose of brokering donations of surplus industrial goods to education. This subscription service provides catalogs and distributes materials nationwide. Contact them directly for details of their service:

National Association for the Exchange of
Industrial Resources
560 McClure Street
P.O. Box 8076
Galesburg, IL 61402
(309) 343-0704

Curriculum Support

In Missouri, the best way to secure up-to-date ITE/TE curriculum information is to contact Missouri's Supervisor of Industrial Technology Education. Also instructors should contact the state's Vocational Resource Center (MVRC, see Table VII-3) and request the help they need. This center supports Missouri's ITE/TE well. It may also be that the MVRC directs you to the state Instructional Materials Laboratory which produces instructional materials. Missouri's and other major centers producing and disseminating useful curriculum and media material are:

Instructional Materials Laboratory
Room 8, London Hall
University of Missouri-Columbia
Columbia, MO 65211
Phone: (314) 882-2883
Toll Free: (800) 392-7217

VTECS
Southern Association of Colleges
and Schools
1866 Southern Lane
Decatur, GA 30033-4097
800-248-7701

Media Center
State Fair Community College
1900 Clarendon Road
Sedalia, MO 65301
Phone: (816) 826-7011

MAVCC
1515 W. 6th Ave.
Stillwater, OK 74074
405-377-2000

Missouri Education Center
Smith Hall
1206 East Walnut
Columbia, MO 65201
(314) 886-2157

If materials cannot be found in-state, the MVRC will conduct a nationwide search as appropriate and usually at no charge. ITE/TE instructors interested in activities with which to implement the new thrust towards technology are also encouraged to contact the Center for Implementing Technology Education (at the Department of Industry & Technology, Ball State University, Muncie, Indiana 47306, 317: 285-5659 for a collection of instructional modules that students can use. Missouri's ITE/TE instructors should note that the MVRC has a subscription to these modules and they can be borrowed from them.

ITE instructors will need much imagination to tap into the wide range of support systems that have potential for helping their programs. The MO ITE Standards Topic 6, as shown in Figure VII-6 provide a convenient way of checking the extent and quality of support system utilization.

Figure VII-6

MOITE Standards, Topic 6: Support Systems

As our technological society advances, resources and support mechanisms will be in constant change; the industrial technology/technology education program should take advantage of new developments and make the best use of current resources and systems. These support systems include human, physical, and financial resources that are necessary to implement the instructional program. These resources are required to provide a comprehensive, quality industrial technology/ technology education program.

Fill in marks to indicate assessment: ∇ **not met**, 0 **met**, Δ **exceeded**

1. **Media/instructional resource center services are provided to support the industrial technology/technology education program.** .... ∇ 0 Δ
2. **Personnel are available to assist the industrial technology/technology education teacher in serving students with special needs** .... ∇ 0 Δ
3. Guidance services are provided to assist all students in determining their interests, aptitudes, and abilities; selecting the program that meets their career/avocational goals; and expanding their individual options. .... ∇ 0 Δ
4. Industrial technology/technology education teachers can obtain interdisciplinary support to assist in achieving program objectives. .... ∇ 0 Δ
5. Secretarial and clerical services are provided for industrial technology/technology education personnel .... ∇ 0 Δ
6. Custodial services are provided, as necessary, to assure safe and sanitary industrial technology/technology education facilities. .... ∇ 0 Δ
7. Maintenance services are provided, as necessary, to assure safe and functional industrial technology/technology education facilities and equipment. .... ∇ 0 Δ
8. **Medical personnel are available, as necessary, to provide instruction and ensure the safety and welfare of students and faculty.** .... ∇ 0 Δ
9. Parents are utilized in achieving program goals and course objectives. .... ∇ 0 Δ
10. The teacher involves individuals from outside the school community to assist in achieving program goals and course objectives, as necessary. .... ∇ 0 Δ
11. An industrial technology/technology education advisory committee is established which has representation of both sexes and the racial and ethnic minorities found in the program areas, schools, community, or region which the local advisory committee serves. .... ∇ 0 Δ
12. The industrial technology/technology educationadvisory committee includes appropriate representation from the public and private sector and/or business and industry .... ∇ 0 Δ
13. The industrial technology/technology education advisory committee is utilized to advise teachers, administrators, and the board of education in planning, developing, implementing, and evaluating the ITE/TE program. .... ∇ 0 Δ
14. The industrial technology/technology education advisory committee meets at least twice a year. .... ∇ 0 Δ
15. Industrial technology/technology educationeducation laboratories average 2500 square feet or 125 square feet per student, per class, exclusive of ancillary space. .... ∇ 0 Δ
16. Industrial technology/technology educationeducation ancillary space, at an average of 500 square feet for each laboratory, is provided for storage of materials, projects/products, and tools. .... ∇ 0 Δ

Figure VII-6

MOITE Standards, Topic 6: Support Systems, continued

Fill in marks to indicate assessment: ∇ **not met,** 0 **met,** Δ **exceeded**

17. Facilities are logically arranged and maintained with consideration given to effective teaching, safety, class management, and economy .... ∇ 0 Δ
18. At least 100 square feet of office space per teacher, within or adjacent to the industrial technology/technology education facility, is provided .... ∇ 0 Δ
19. Facilities are reviewed annually and modified, as needed, to accommodate changes in the course objectives and changes in technology. .... ∇ 0 Δ
20. Accessibility for the handicapped is ensured through the elimination of architectural barriers .... ∇ 0 Δ
21. Consumable supplies and materials are provided in sufficient quantity and quality to achieve course objectives. .... ∇ 0 Δ
22. Properly maintained tools, machines, and equipment are available on the basis of their instructional value in fulfilling program goals and course objectives. .... ∇ 0 Δ
23. Specially designed or modified tools, machines, and equipment are provided for students with special needs, if required .... ∇ 0 Δ
24. Books and other instructional materials are supplied in sufficient quantity to meet program goals and course objectives. .... ∇ 0 Δ
25. Books and other instructional materials contain sex- fair language and images and provide a wide range of role options. .... ∇ 0 Δ
26. Books and other instructional materials are provided to meet the unique requirements of students with special needs, as necessary .... ∇ 0 Δ
27. Resource materials developed or approved by the state education agency are available and utilized at the local level. .... ∇ 0 Δ
28. The program is supported by an annual written budget based upon the program needs and student enrollment. .... ∇ 0 Δ
29. Funds are budgeted for equipment maintenance or replacement and for facility improvements to accomplish course objectives. .... ∇ 0 Δ
30. Budgeted funds for supplies, curriculum and resource materials are expended to fully achieve .... ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): — — —

4. Using Advisory Committees

Advisory committees at the state and local level should help educators determine the nature, content and activities of each course. In addition, they can provide valuable input regarding the facilities required to implement the program. Local committees are helpful in determining community needs and in identifying the human and material resources available from within the community and local industry.[1]

Although it is important to note that such committees are not policy or decision making groups, their services are valuable and should be given every consideration. But finally, it is the responsibility of the ITE/TE instructor and the school's administration to decide whether (and how) the recommendations are to be implemented.

Local advisory committees may be the single most important source of information and assistance available to the ITE/TE teacher. Considerable assistance can be obtained from these committees. However, in interaction with state and national advisory committees an even broader perspective on programing, industrial needs and available resources is available.

ITE/TE advisory committees are helpful in determining community needs and in identifying the human and material resources available from within the community and local industry.

One overall advisory committee should be established for the ITE/TE program. If the school has a vocational or community advisory committee/group/ organization, then it is important that a representative from the ITE/TE advisory committee serve on the other advisory group for liaison and coordination purposes. Similarly one ITE/TE advisory council member should be designated to establish a correspondence link with the national Technology Education Advisory Council. Such correspondence should be directed through the ITEA national office. Another member should keep in touch with Missouri's Council on Vocational Education.

National Technology Education Advisory Council

At the National Level, the Technology Education Advisory Council (TEAC) was established to provide information to the technology education profession about current developments and possible trends in technology and industry and about the implications of those trends for technology education. As such the TEAC services to:

- Recommend ways of resolving discrepancies between the programs and philosophies of technology education and current industrial/technological practices.
- Recommend content directions to improve the relevance of technology education.
- Suggest methods of improving the public's perception and understanding of technology education.
- Facilitate the cooperation between industry and education to improve the education of youth.

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[1] *Guidelines for Industrial Arts in Career Education*, n.d.

The TEAC's recommendations are advisory since the council has no official policy-making authority. The council's topics of discussion vary as the association's membership suggests or as requested by the ITEA's Board of Directors—the TEAC's sponsoring group.

Local ITE/TE Advisory Committees[1]

The duty of local industrial technology/technology education advisory committees is to counsel and advise ITE/TE instructors, supervisors, school administrators and the school board concerning the directions, management and supervision of the ITE/TE program. Generally these committees also assist in the development and maintenance of the ITE/TE curriculum and facility. An excellent guide (Behymer) to the use of advisory committees is available from UMC's Instructional Materials Laboratory.

Local advisory committees provide community and industrial input to teachers and counselors. They are not policy- or decision-making groups, rather they advise by **reviewing** policies and programs, by **expressing** opinions on programs, services, facilities and learning activities and by **identifying** trends, priorities and resources. It is recommended that such committees be asked to submit an annual report as well as such special reports as appropriate. It is also important that the advisory committee addresses the ITE/TE program's relationship to the overall school curriculum. Other recommended advisory committee activities include:

- Making recommendations regarding program content and needed curriculum, equipment and facility changes.
- Providing information and technical assistance necessary to update the program.
- Assisting in developing performance objectives
- Assisting in developing and conducting community surveys.
- Providing with information regarding new career opportunities.
- Assisting in obtaining community resources.
- Assisting in the development and promotion of good public relations.
- Assisting in the evaluation and review of the program (Towler, p. 75).

Local ITE/TE Advisory Committee Membership

There is no one answer to the optimum size of an advisory committee. Each committee should be comprised of members representative of the community it serves. Normally however, about seven members (less in small communities) will provide adequate coverage of geography, minorities and industries within a given community. The following should provide helpful guidelines for selecting committee members.

- Industry representatives, e.g.:
  - One individual from the communications industry.
  - One from energy/power.
  - One from materials processing industry

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[1] Adapted from Towler, pp. 75-76.

- One ITE/TE educator
- One or more parents (can be identified by the local PTA)
- One or two students (at least one should be female)
- One representative from the school or system's administration
- One individual representing vocational education
- One specialist in the area of special needs populations

Some method of membership rotation should be devised prior to the actual formation of a committee. Fresh viewpoints and ideas are essential to properly address our rapidly changing technological world. For this reason, only under exceptional circumstances should the reappointment of a committee member be considered. One workable way to address the rotation of committee members is to make their initial terms of varying length—typically one, two and three years are used.

Advisory committees could of course use consultants, on a temporary basis, to assist in solving specific problems. Specialists in areas outside of the committee's areas of expertise can serve on a temporary basis until a specific problem or concern is adequately addressed. If this arrangement is used the consultants would not have voting privileges in committee matters. Their services would be on a strictly consulting basis.

Local ITE/TE Advisory Committee Operations

Selection of Officers

Each advisory committee should elect a chair and a secretary. It is recommended that a teacher or administrator not serve as chair, but may serve as secretary.

Officer duties

The chair:

- Shall call and preside at all committee meetings.
- Shall schedule all meetings and make necessary committee assignments.
- Should prepare and agenda for each meeting.

The secretary:

- Will record, maintain and distribute minutes of every meeting to each member of the committee.
- Is responsible for notifying members of the meeting date, time and place.
- Should provide all members with an agenda and issues to come before the committee prior to the meeting, preferably one week in advance.

Meetings

It is recommended that:

- The initial meeting be held within thirty days following appointment of the committee. The superintendent, or a representative, should call this meeting and preside until a chair is selected.
- The committee members be acquainted with the purpose and duties of the committee.

- Committee meetings be planned for specific purposes. Behymer's guide provides an excellent outline for a program of work.
- Regular scheduling of meetings be determined by membership, based on existing problems and important matters for consideration.
- The committee should establish its own governance rules.

The School's Responsibility to Committee Members

Committee members should be informed, by an official letter from the superintendent of schools, that membership is an official act which has state approval. The committee and school administrators should work in harmony to serve a definite purpose. Committee members must be advised that they are resource persons to improve curricula, facilities, teacher preparation, occupational information, community surveys and public relations. (Towler, p. 76)

5. Organizing & Managing ITE/TE

Managing Student and Other Records

Industrial Technology/Technology Educators have a large responsibility in tracking and recording student progress. The results of homework, projects, activity observations, exercises and tests all have to be recorded. Fortunately standard record books exist for such things. They can be purchased at any large school supply store. Increasingly common are computer-based approaches for such management tasks. Usually these are called instructional management systems. The Missouri Vocational Administration Management System (VAMS) is an example often found at Area Vocational Schools. Additionally, Missouri distributes and supports C-VAMS (a classroom version of VAMS), Project BASIC III, and is even developing a new teacher-focused system. Versions of these systems are available to run on Apple IIe and/or MS-DOS compatible computers. Further details are available from Missouri's State Supervisor of Industrial Technology Education, or:

VAMS Support Center
Department of PAVTE
324 Townsend Hall
University of Missouri-Columbia
Columbia, MO 65211
314: 882-2951

Generally instructional systems management software helps teachers in the following tasks:

- Assessing student performance through automated recording of mastered competencies based on computer scored tests
- Maintaining a record of student performance by specific competencies
- Printing out individualized or class performance/progress reports
- Linking and cross-referencing competencies to instructional materials and test questions
- Scoring tests conveniently

ITE/TE teachers face serious challenges handling the many information demands and organizational tasks facing them. Safety mastery has to be logged, attendance recorded, costs determined, bills calculated, maintenance pursued, materials ordered, shelf-life tracked, grades worked out, enrollment analyzed, student progress monitored, remediation needs identified, and many others attended to. Figure VII-7 depicts some of the more important elements of the constellation of data teachers/students have to work with daily. Consequently, ITE/TE instructors often build their own management systems. Computer database and/or spreadsheets programs are most often used for this. Visi-calc™, Lotus™, Excel™ and Appleworks™ are some of the most frequently used programs but many others can be used as well. Nor does the brand of computer really matter--all can help.

Teachers are called upon to use various elements of this information in a thousand and one ways. They help students, report to administrators and parents, monitor progress, assign remediation, calculate grades, etc. Furthermore, one of the most important characteristics is that all this occurs efficiently and easily because teachers have very little time for such tasks.

Instructional management systems are essential to the efficient operation of competency-based ITE/TE.

Simply put, this means teachers need to harness the power of the computer to work both **easier** and **smarter**. With declining computer and software prices, this capability is reaching everyone in ITE/TE. Furthermore, the software's power is increasing rapidly just as is its ease of use.

ITE/TE teachers are advised to systematically build a database that consists of the elements identified in Figure VII-7 Note that this database should be designed in modular fashion so teachers begin by inputting just those data elements that they need most urgently. Then, gradually add additional data elements as needed and when time permits. Contemporary databases allow this approach and they are more reliable since a problem in one set of fields won't crash the others.

To make the database most helpful, teachers need to pre-design report forms that draw on various data elements in the database, to address the particular need teachers are facing. Teachers typically need to:

1. Report student progress
2. Order supplies for the next term
3. Maintain equipment
4. Report student grades
5. Print out a list of which students are to work at which work station this rotation
6. Prepare a rotating schedule of cleanup assignments
7. Etc.

Figure VII-7

Sample Database Elements

Student Data

Name
Parent Permission (date signed)
Student Health conditions
Special needs classification
Grade
Year (date)
Project card (table)
Date/item description/quantity/$
amount per/total$
...
...

Performance Data

Pre-test
Demonstration (machines & tools)
Safety test
Safety test passed (date)
Performance test
Performance test passed
Follow up evaluation
Mid-term testFinal
Examination
Attendance
Teacher comments
Assignment 1 grade
Assignment 2 grade
...
...

Materials Inventory

Item name
Description
Name of vendor (contact person)
Quantity in stock
Approximate # needed yrly
Order quantity
Date purchased
Quantity purchased new
Price per
Hazardous items
Shelf-life
Shelf Life Date
MSDS on file
...
...

Instructional Data

Class
Course name
Enrollment
C&D #s
Grade
Year (date)
Schedule pattern
Teacher name
Assignment 1 weight
Assignment 2 weight
...
...

Equipment & Facility Data

Equipment inventory
Date purchased
Serial and model #s
Where purchased (vendor)
Contact person
Maintenance schedule
Parts regularly purchased
(vendor/price/order, e.g., blades)
Condition
Space availability
Maintenance schedule
Utility contacts
...
...

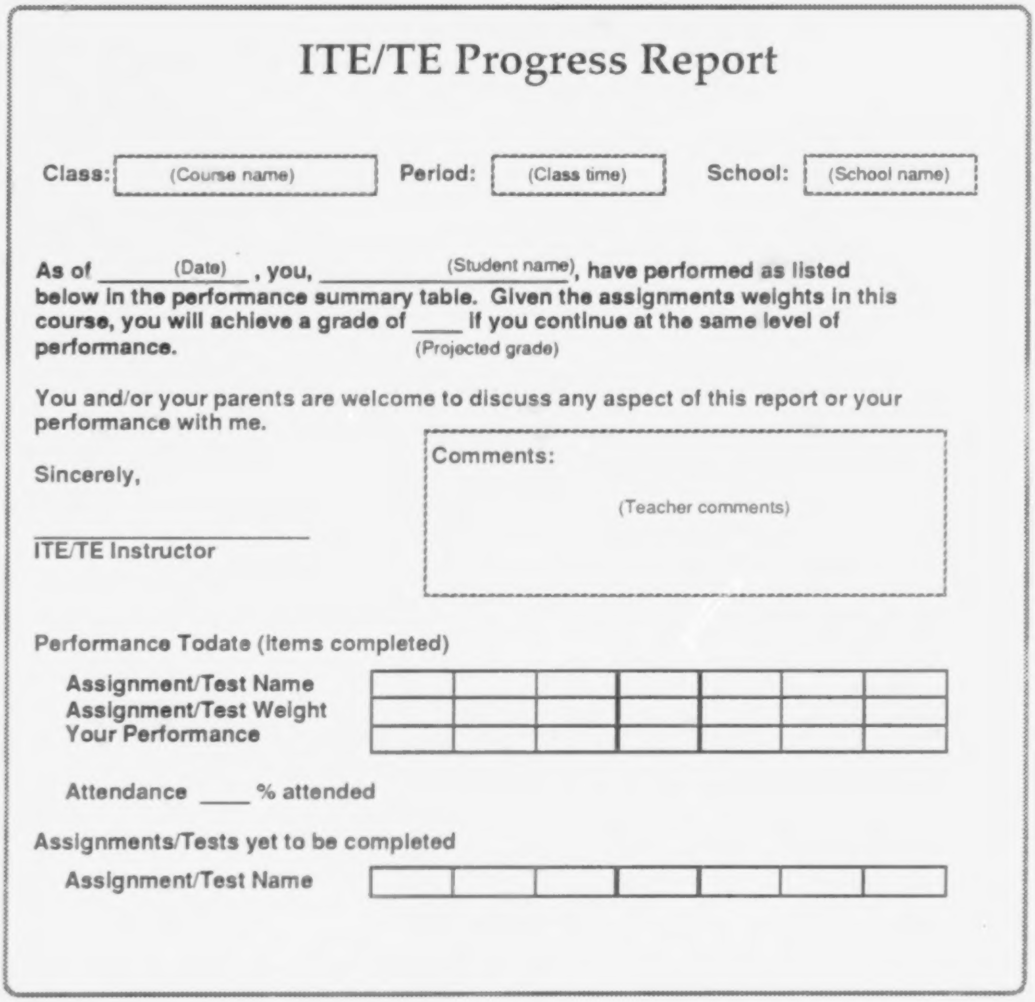
Now, for example, to report student progress, as shown in Figure VII-8, teachers will need to call up the data elements listed below to create a report that gives each student his/her progress report.

- Student name
- Names of each assignment graded to date
- Grade for each assignment to date
- Weight (proportion of overall grade) for each assignment submitted
- Names of assignments yet to be graded
- Attendance to date

- Projected final course grade based on existing performance. (Note the database calculates this based on a formula you tell it when designing the report form. The formula will insert the scores earned by the student and then projects the final grade using their average in place of any missing scores.)
- Today's date
- Course name
- Class period
- Teacher name
- Teacher comment

Figure VII-8

Sample Progress Report From Database



ITE/TE Progress Report

Class: (Course name) **Period:** (Class time) **School:** (School name)

As of ___(Date)___ , you, ___(Student name)___, have performed as listed below in the performance summary table. Given the assignments weights in this course, you will achieve a grade of ____ (Projected grade) if you continue at the same level of performance.

You and/or your parents are welcome to discuss any aspect of this report or your performance with me.

Sincerely,

____

ITE/TE Instructor

Comments:

(Teacher comments)

Performance Todate (items completed)

Assignment/Test Name							
Assignment/Test Weight							
Your Performance							

Attendance ____ % attended

Assignments/Tests yet to be completed

Assignment/Test Name							

In short, the essence of good data management is to have a variety of such data report forms available so that teachers just call for the information instead of having to work at getting it out. Careful design of the data elements is also critically important so that teachers do not bog down laboriously inputting data. In fact, with the proper quality control checks, students can enter much of their own data. Another way to ease data input load is to use optical scoring machines that enter data directly from student answer sheets.

A side benefit of computerized approaches is the ease with which reports and summaries can be prepared. This helps teachers increase the amount of feedback to students and parents—and it does so without significantly adding to the instructor's work load. Yet another benefit is that all such records are typically in one place—no chasing after various and sundry records is needed.

There is a responsibility for record security the instructor must assume. Given the capabilities and interests of today's students, each ITE/TE instructor using a computerized record keeping system must install some procedure for guarding the integrity of these records. Locking the disks in a secure place is one inexpensive yet effective way to accomplish this.

Managing Field Trips

Instructors cannot assume that field trips are "just another teaching method." Because such trips typically expose students to hazards they would not encounter at school, boards of education often establish specific policies for such trips. Typically these policies involve securing parental permission, meeting insurance requirements and controlling the means of transportation. ITE/TE instructors must be sure to follow these local policies in detail in order to qualify for insurance coverage, minimize liability and risk to students.

On the field trip, instructors should take with them a list of student names and emergency contacts. Then they must also exercise careful control over the class for the entire duration of the excursion. It is always recommended that the trip begin and end at school; do not allow students off at various points along the way.

Inventorying Equipment and Tools

Essentially ITE/TE instructors are responsible for the equipment and tools in their laboratories. To properly account for the public's investment in ITE/TE, it is recommended procedure to inventory the facility at the start and end of each school year. Such a form or database record, a sample of which is shown in Figure VII-5, should include as a minimum the following information.

- School name
- Laboratory name
- Item name
- Item description
- Inventory number
- Date inventoried
- Condition code
- Signature of person verifying inventory

School: ______________________ **Laboratory:** ______________________ **Page** __ **of** __

				Inventory							
				School Start: __/__ By: ________		School End: __/__ By: ________		School Start: __/__ By: ________		School End: __/__ By: ________	
Item Name	**Description**	**Value**	**Inventory No.**	Date	Condition*	Date	Condition*	Date	Condition*	Date	Condition*

* Condition Code: E = Excellent, A = Average, P = Poor, M = Missing, X = Needs Replacement

Figure VII-9 ITE Inventory Form

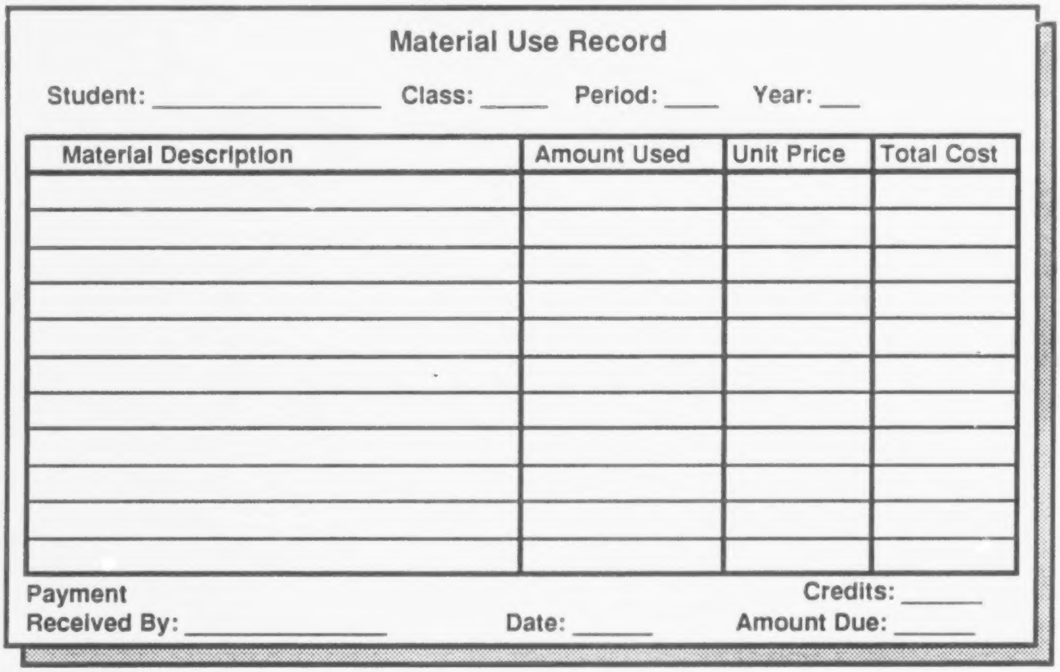
Managing Supplies

The management of supplies presents ITE/TE instructors with more challenge than equipment does. Typically there is a greater number of supplies which have to be tracked. Furthermore, many supply items are sold and/or consumed by students. Additionally some items have shelf-lives that need to be considered.

To address this challenge, it is recommended that instructors keep a materials card or data-base record for each student. On this card, either the student or instructor records the materials used (or issued) each time. Then, at the end of each period or term it is relatively easy to charge the appropriate amount. Figure VII-8 shows a form that can help document material usage.

Figure VII-10

Material Use Record



Material Use Record

Student: ________________ **Class:** _____ **Period:** ____ **Year:** ___

Material Description	Amount Used	Unit Price	Total Cost

Payment **Credits:** ______

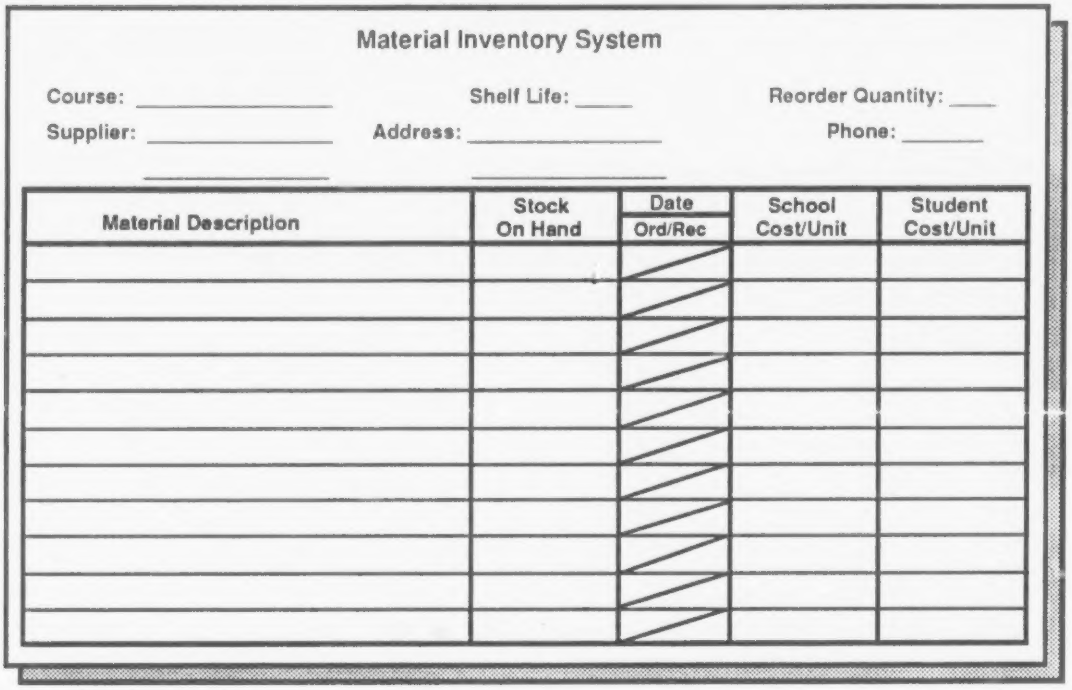
Received By: _______________ **Date:** ______ **Amount Due:** ______

The maintenance of a supply inventory is facilitated if the instructor develops a list of what items should be at hand. Then he/she should augment this with quantity points, which when reached, trigger a resupply order. All that remains then is to conduct a monthly or bimonthly inventory of the supplies on hand to see of these points have been reached or exceeded. Figure VII-9 shows a form that can help track a supply inventory.

Finally, because of the multitude of small supplies needed to keep the typical program operating, it is recommended that ITE/TE instructors each be allocated a small revolving cash fund. This should be used for incidental local purchases. At the end of the year an accounting of this money should be made to the principal or department chairman.

Figure VII-11

Material Inventory System



Material Inventory System

Course: ________ Shelf Life: ____ Reorder Quantity: ____

Supplier: ________ Address: ________ Phone: ______

Material Description	Stock On Hand	Date Ord/Rec	School Cost/Unit	Student Cost/Unit

6. Resources

________. (1984). *Computer programs in industrial arts/industrial technology education.* South Holland, IL: Goodheart-Wilcox.

________. (1985). *Industrial technology systems handbook for industrial arts/technology education.* Columbus, OH: The Ohio State University/Ohio Industrial Arts Association.

________. (1985). *Directory of curriculum guides and other key resources.* Reston, VA: International Technology Education Association.

________. (1985, June). *Resource directory of curriculum centers/labs.* Stillwater, OK: Vocational Instructional Materials Section (AVA) and National Network for Curriculum Coordination in Vocational Technical Education, Revised.

________. (1986). *Directory of colleges & universities offering degrees in technology education/industrial arts.* Reston, VA: International Technology Education Association.

________. (1989). *Educator's guide to free audio and video materials.* (also *...free films, ...free filmstrips, ...free science materials, ...free teaching aids, ...free computer materials*) Randolph, WI: Educator's Progress Service.

________. (1989). *Technology student association: Chapter handbook.* Reston, VA: TSA.

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________. (N.D.). *Guidelines for industrial arts in career education.* Pittsburgh, PA: University of Pittsburgh.

________. (N.D.). *Handbook for advisory council members.* Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia, n.d.

________. (N.D.). *Quality features for industrial education programs: A guide designed to enhance and support the Illinois plan.* No. 278a. Macomb, IL: Illinois State Board of Education.

________. (N.D.). *Using the computer in industry.* Dekalb, IL: Northern Illinois University.

Barnes, J. L. (1984). *Systems of technology: Organization and management of instruction handbook.* Austin, TX: University of Texas-Austin, Center for Occupational Curriculum Development.

Behymer, J. (1985). *Handbook for instructors involving vocational advisory groups in program* improvement. Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia [VE-49-1].

Dennis, E. A. (Compiler). (Annually). *Industrial teacher education directory.* Cedar Falls, IA: Council on Technology Teacher Education/National Association of Industrial and Technical Teacher Educators.

Dyrenfurth, M. J., & Linhardt, R. E. (1981). *Vocational safety guide.* Columbia, MO: Instructional Materials Laboratory, University of Missouri-Columbia.

Miller, W. R. (1990). *Instructors and their jobs.* Homewood, IL: American Technical Publishers.

Saterstrom, M. H. (Annually). *Educator's guide to free guidance materials.* Randolph, WI: Educator's Progress Service.

Towler, A. L. (N.D.). *The industrial arts guide.* Austin, TX: Center for Occupational Curriculum Development, The University of Texas-Austin.

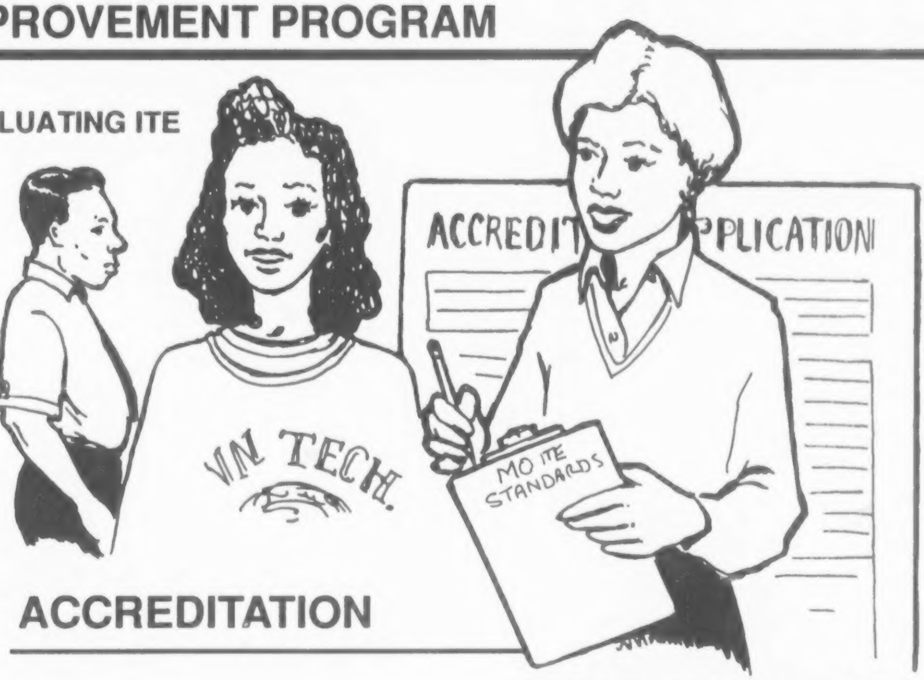
Notes:

Chapter VIII

Evaluating Industrial Technology/ Technology Education

MISSOURI SCHOOL IMPROVEMENT PROGRAM

EVALUATING ITE


ACCREDIT PPLICATION
VN TECH.
MO ITE STANDARDS

ACCREDITATION

PROGRAM STANDARDS

EVALUATING ITE/TE TEACHERS

Chapter VIII

Evaluating Industrial Technology/Technology Education

1. Introduction & Overview

Overview

This chapter highlights the three main evaluations ITE/TE instructors deal with on a regular matter. As professionals, they need to be concerned with: Evaluation of the ITE/TE program, evaluation of student performance and evaluation of the ITE/TE instructor him/herself. Important guidelines for each of these three types of evaluations are described in the following sections.

Objectives

1. To present key recommendations for the evaluation of the overall ITE/TE program.
2. To share useful suggestions and principles for effective evaluation of student performance and grading.
3. To highlight the procedures and criteria used in Missouri's performance-based teacher evaluation.

Chapter 8 Outline

1. **Introduction & Overview** 1
2. **Evaluating the ITE/TE Program** 1
3. **Evaluating ITE/TE Teacher Effectiveness** 24
4. **Resources** 33

2. Evaluating the ITE/TE Program

Overview

There are basically three types of evaluations an ITE/TE **program** can undergo: local (internal) evaluation, school accreditation and state evaluation. Each evaluation serves a different purpose but all focus on program improvement.

Local (Internal) Evaluation

These evaluations focus on the improvement of instruction and are conducted by school personnel. Such "in house" evaluations are often conducted on a yearly basis. This type of evaluation should not be informal and incidental, but rather formal in nature. In other words the process should be conducted on a formalized, scheduled and official basis with the results recorded for the board of education's review. These internal program reviews allow school personnel to make adjustments to programming, facilities and equipment, often with the guidance of the ITE/TE advisory committee. The Missouri ITE Standards (available from Missouri's ITE Supervisor) are an excellent basic framework for this kind of evaluation.

School Accreditation

Missouri schools may elect to pursue external and/or state accreditation. The North Central Association of Schools and Colleges (NCA) provides the mechanism for external accreditation. The accreditation process is voluntary and thus is quite flexible in permitting local procedures to vary considerably. However the basic elements and sequences are typically similar. They involve:

1. A request for accreditation to NCA
2. Conduct of a self-study that involves:
   - Formation of a local committee
   - Self-evaluation of each program (ITE/TE is one)
   - Self-evaluation of school- and community-wide functions
   - Compilation of appropriate documentation
3. Establishment of a visiting team
4. Visiting team's review of self-study as prepared by the school's local team
5. Visiting team's on-site visit including:
   - Program by program review
   - Overall function review
   - Validation of documentation
   - Exit report
6. Visiting team's report of findings
7. Visiting team leader and local committee interaction establishing required follow-up
8. One year follow-up of required action

Basically it is important for ITE/TE instructors to consider such accreditation procedures as an opportunity—not a threat. To facilitate this it is strongly encouraged that the local ITE/TE instructors nominate two or three highly respected industrial technology education/technology educators to serve on the visiting team. Don't just select friends or colleagues who you think would be "easy" on the program. Often such accreditation reports provide just the kind of support that secures long-needed improvements.

> **Basically it is important for ITE/TE instructors to consider such accreditation procedures as an opportunity—not a threat.**

The NCA does not mandate any given set of evaluation instruments. Instead it encourages local institutions to use standards of "appropriate professional organizations." To ease matters however, the **NCA** provides a set of evaluation criteria that are produced by the National Study of School Evaluation (NSSE). A sample page from the latest version of their Technology Education (Industrial Arts) criteria is provided in Figure VIII-1. Because of the national approval process used, such criteria lag somewhat behind the profession's pulse so these criteria do not necessarily represent the profession's most current thinking. Therefore it is recommended that for accreditation purposes, local schools update the NSSE criteria with the Missouri ITE Standards (available from Missouri's Supervisor of ITE). The combined use of these two sets of criteria would make for an exceptionally strong self-evaluation.

State (DESE) Evaluation

Missouri's Department of Elementary and Secondary Education recommends that all ITE/TE programs be evaluated periodically. For programs receiving special state and/or federal funding, such evaluations typically need to be conducted at least once every five years. The current program for such evaluations is called the Missouri School Improvement program and it should be fully phased in by 1994.

The MO ITE Standards are based on the National TE Standards.

As with accreditation procedures, it is recommended that state evaluations begin with a systematic self-evaluation. To help in this, Missouri DESE's industrial technology section provides a set of standards and evaluation criteria. These are also found in appropriate chapters of this guide. They are based on the national standards for technology education, and they were subsequently endorsed by the Missouri Industrial Technology Education Association (MITEA) and the Industrial Technology Education Division of the Missouri Vocational Association. This instrument, a sample of which is provided in Figure VIII-2, includes administration, evaluation, instruction and recommendations sections. State evaluation also involves a visiting team's on-site evaluation. As with accreditation assessment, it is strongly recommended that ITE/TE instructors present a fair and complete picture of their program's strengths and weaknesses.

Local Evaluation

In the Missouri Vocational Program Evaluation Project's *Administrator's Handbook*, Chapter III outlines a detailed procedure that will be effective for the overall local evaluation of a school. The recommended procedure shown in Figure VIII-3 is adapted from this project's model. The local program evaluation committee—a central feature of this procedure is recommended to include people such as:

- The ITE/TE Advisory Committee chair-person or representative
- Recent program alumni
- ITE/TE program teacher/administrators
- Outside experts
- Parents and community representatives
- State department supervisor or designee

The evaluation system is based upon the collection and interpretation of data from three sources: Data in reports to the Department of Elementary and Secondary Education, local documentation and specific evaluation instruments. Synthesis of information from all of these sources will provide an accurate picture of the quality of the program at the local level.

It is expected that the teams and individuals involved will meet as necessary to effect a thorough evaluation. A time span of 30 to 90 days is recommended for Activities 1 through 9. Throughout the evaluation it will be necessary for the participants (i.e., the local evaluation team, the team's chair-person and the school's administration) to keep each other informed as to their activity. Also important is that access, by all involved parties, to relevant information is made easy.

Figure VIII-1

Evaluative Criteria from the National Study of School Evaluation: Technology Education (Industrial Arts), 6th Edition[1] (sample page)

Section 4-16 Technology Education (Industrial Arts).

• • •

4. Teachers plan and provide for evaluating the effectiveness of their instruction .... 5 4 3 2 1 n/a
5. Alternatives and appropriate methods to assist students in meeting course objectives are provided by teachers. .... 5 4 3 2 1 n/a
6. Students develop an insight and understanding of the technological society as a result of activities in courses .... 5 4 3 2 1 n/a
7. Emphasis is placed upon improving student ability to make informed and meaningful career choices .... 5 4 3 2 1 n/a
8. Technology education prepares students for collegiate and/or advanced vocational/technical programs and equips them with universally transferable technological skills. .... 5 4 3 2 1 n/a
9. Emphasis is placed upon preparing students for life-long learning in a technological society. .... 5 4 3 2 1 n/a
10. Instructional activities develop student skills, positive self-concepts and individual potentials in technology. .... 5 4 3 2 1 n/a
11. Instructional activities are designed to teach the application of tools, materials, machines, processes and technical concepts safely and efficiently. .... 5 4 3 2 1 n/a
12. Instructional activities promote the development of process skills such as creative and critical thinking, decision making and problem solving. .... 5 4 3 2 1 n/a
13. Both teacher-centered and student-oriented instructional methods are utilized.. 5 4 3 2 1 n/a

• • •

Rating Scale

5 = Excellent 4 = Good 3 = Fair 2 = Poor 1 = Missing but needed N/A = Not Applicable

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[1] The complete evaluation instrument for Technology Education (Industrial Arts) may be secured from Dr. Robert C. Shaw, 218 Hill Hall, University of Missouri-Columbia, Columbia, MO 65211 or Missouri's Industrial Technology Education Supervisor.

Figure VIII-2

MO ITE Standards (Sample)

Topic 10

Evaluation Process

Industrial technology /technology education programs will constantly change to reflect the society. Program teachers and others will need to apply the evaluation process on a regular basis to assess program progress. The statements contained within this standard topic concern the evaluation process. All elements of the program are systematically and continuously assessed and compared to desired standards. The standards in this document serve as bases for the evaluation of these programs

Fill in marks to indicate assessment: **∇ not met, 0 met, Δ exceeded**

1. Instruments, based upon the standards contained in this document, are designed and/or selected to obtain valid and reliable information. ∇ 0 Δ
2. Instruments are administered annually to collect valid and reliable data on selected aspects of industrial technology/technology education program. ∇ 0 Δ
3. Data on the total industrial technology/technology education program are collected at least once every five years. ∇ 0 Δ
4. Data are collected, as necessary, for compliance with accrediting agencies, and state and federal mandates. ∇ 0 Δ
5. Valid procedures are utilized to analyze data and identify discrepancies between the current program and the standards in this document. ∇ 0 Δ
6. Findings from the data collection and analysis efforts are disseminated to the evaluator, the evaluate, and to appropriate decision makers. ∇ 0 Δ
7. Discrepancies between program status and standards are reported to appropriate decision makers. ∇ 0 Δ
8. Recommendations for correcting deficiencies are reported to appropriate decision makers. ∇ 0 Δ
9. A written course of action is developed, with priorities determined, actions implemented, and results assessed for effectiveness in dealing with each deficiency. ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): ___ ___ ___

Activity 1: Establish Evaluation Team

The school's principal or superintendent should appoint the local evaluation team. It is this team's responsibility to identify all factors to be evaluated, to collect appropriate data, to assemble the relevant documents and to develop and present the evaluation report to the administration. The team is advised to keep minutes of their regular meetings and to keep key people informed.

Note that tailoring of team membership is encouraged. The team should be deliberately formulated to result in a comprehensive evaluation.

Activity 2: Initial Planning Meeting

Conduct a preliminary planning and briefing meeting with the entire evaluation team and the school's superintendent or principal. At this meeting the chair-person clarifies any procedural concerns, provides technical advice when necessary, establishes timelines and assigns individual responsibilities.

Activities 3, 4, 5, & 6: Data Collection

These steps involve collection of data necessary to complete the evaluation picture by the local evaluation team. The plans and procedures for such activity would involve procedures approved at the preliminary planning meeting (Activity 2) or at subsequent meetings. Included are:

- Consolidation of data from reports to Missouri's Department of Elementary and Secondary Education.
- Review of the institution's files for information of relevance to the evaluation of the ITE/TE programs. Included in such reviews would be:
  - The most recent North Central Association accreditation report
  - Evaluative reports filed by DESE and Vocational Education personnel
  - Institution classification and/or Missouri School Improvement Program documents
  - Institution and/or program advisory council reports
  - Previous self-evaluations
  - Official budgets and records of expenditures
  - Follow-up evaluations
  - Institution and/or board policy handbooks
- Analysis and synthesis of information contained in such documents to form the supportive rationale for the local evaluation.
- Synthesis and analysis of information obtained from the use of any specific instruments and procedures required to fill information gaps identified in Activities 4 and 5.

Activity 7: Development of Evaluation Report

At this stage, the local evaluation team pulls together the information obtained through activities 3, 4, 5 and 6. The team then weighs the evidence and develops a final written evaluative report. Figure VIII-4 outlines a tentative format.

Activity 8: Submitting Evaluation Report

The local evaluation team prepares copies of their report and submits them to the school's administrators. Together they then schedule a time for formal presentation of the evaluation's findings.

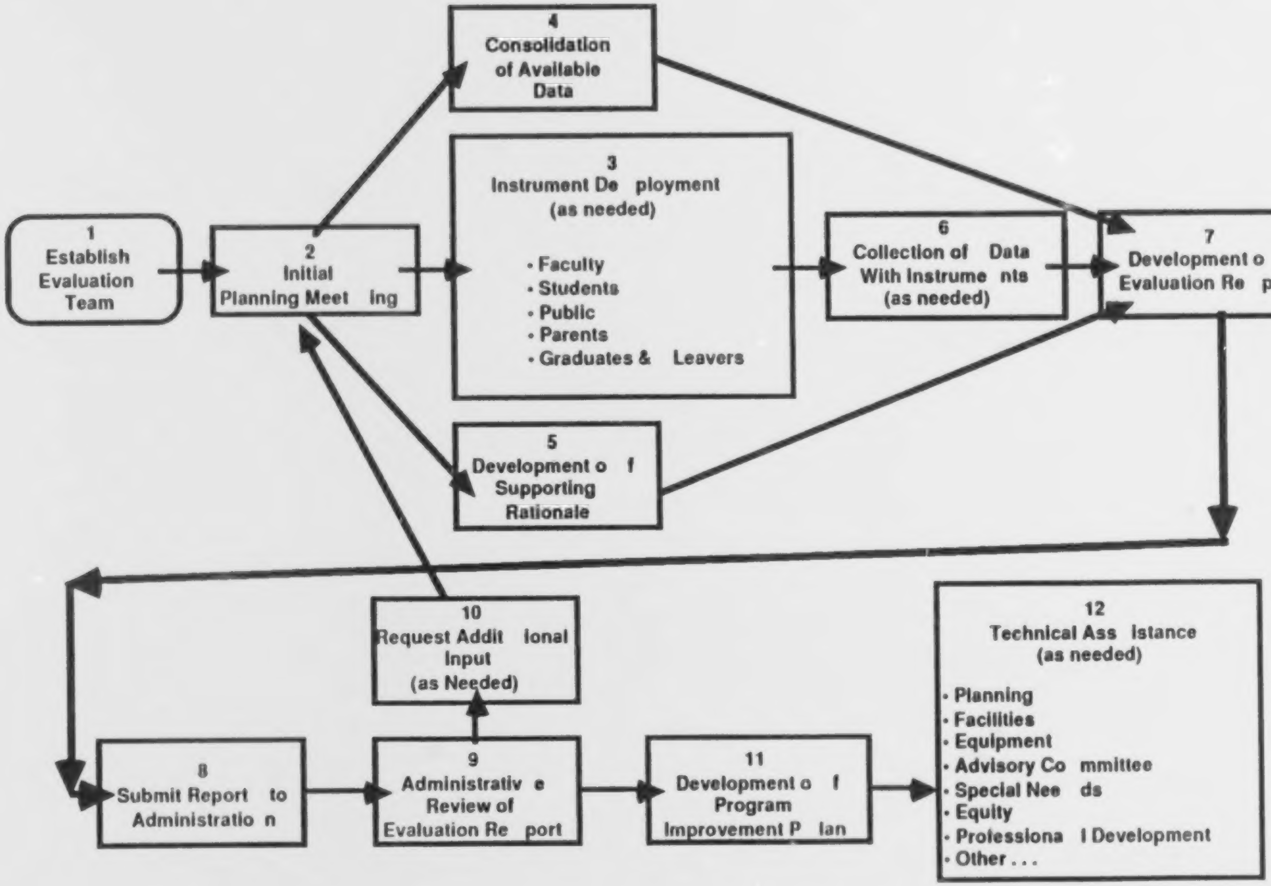
4
Consolidation of Available Data
3
Instrument Deployment (as needed)
• Faculty
• Students
• Public
• Parents
• Graduates & Leavers
1
Establish Evaluation Team
2
Initial Planning Meeting
6
Collection of Data With Instruments (as needed)
7
Development of Evaluation Report
5
Development of Supporting Rationale
10
Request Additional Input (as Needed)
12
Technical Assistance (as needed)
• Planning
• Facilities
• Equipment
• Advisory Committee
• Special Needs
• Equity
• Professional Development
• Other . . .
8
Submit Report to Administration
9
Administrative Review of Evaluation Report
11
Development of Program Improvement Plan

Figure VIII-3 Local Evaluation System Procedures[1]

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[1] Adapted from Elias & Dyrenfurth, 1980

Activity 9: Administrative Review of Report

The school's administration now evaluates the report and its findings as well as any clarifications pursued at the formal presentation.

Activity 10: Supplying Additional Information

Administration requests additional information and/or explanations as needed.

Activity 11: Developing Program Improvement Plan

The local evaluation committee, together with the ITE/TE program's teachers and supervisors, then plan and detail the program improvement needed. Objectives, plans, equipment acquisitions and needed renovations should all be incorporated as well as any other items that the evaluation called for.

The local evaluation committee, together with the ITE/TE program's teachers and supervisors, then plan and detail the program improvement needed.

Activity 12: Securing Technical Assistance

The school's administration and Missouri DESE's Industrial Technology section and other appropriate individuals supply the technical assistance necessary to implement the program improvement plan.

Figure VIII-4

Suggested Local ITE/TE Evaluation Report Format[1]

1. Title page
2. Table of contents
3. Brief narrative description of the institution and its setting
4. Evaluation team
   - Team composition
   - Key minutes
5. Procedures employed by local evaluation teams
   - Data collection and instrumentation
   - Populations surveyed
   - Schedule of activities
6. Quantitative and qualitative data summary
   - Locally collected
   - Longitudinal reports
   - ...
7. Supportive statements for each major evaluation topic
   - Needs assessments
   - Inputs
     - statements of goals and objectives
     - program of work
     - resources allocated
   - Process characteristics
   - Key outputs
8. Findings and conclusions
   - Strengths
   - Weaknesses
     - mitigating factors
     - recommended strategies for addressing weaknesses
     - requests for technical assistance
9. Appendices
   - Samples of each instrument used
   - Titles and locations of supportive documents available at the school

---

[1] Adapted from Elias & Dyrenfurth, 1980.

Keying to State Goals and Competencies

One of the strongest arguments to be made for the ITE/TE program is its contributions to the educational goals for the state of Missouri and the core competencies and key skills that define them. The latest versions of the complete texts of these are available from Missouri Department of Elementary and Secondary Education.[1] Given the importance of these goals and competencies, it is also important that the ITE/TE's evaluation documents the link between ITE/TE participation and the achievement of Missouri's education goals and core competencies. Therefore industrial technology/technology educators would be well advised to build into their evaluation questions and methods that secure data to show how their program contributes to the mastery of core competencies by advancing their students':

> **One of the strongest arguments to be made for the ITE/TE program is its contributions to the educational goals for the state of Missouri and the core competencies and key skills that define them.**

- Intellectual Development in the areas of:
  - Communication (oral and written English)
  - Quantitative thinking (mathematics)
  - Social processes (social and behavioral studies)
  - Scientific understanding (science, chemistry, physics...)
  - Decision making
  - Aesthetic sensitivity
  - Technological literacy
- Physical Development in the areas of:
  - Growth and motivation
  - Health
  - Recreation
- Social Development in the areas of:
  - Social and physical environment
  - Cultural awareness
  - Governmental institutions and citizenship
  - Avocational pursuits
  - Concept of self, morality and values
  - Employability skills
- Career Development in the areas of:
  - Social significance of work
  - Occupational exploration
  - Occupational preparation
  - Occupational education (adult training and/or retraining)

---

[1] Missouri Department of Elementary and Secondary Education, P.O. Box 480, Jefferson City, MO 65102

Follow-up Evaluations

As part of any of the types of evaluations (local, accreditation, state) a follow-up of students can provide many useful insights. Therefore it is recommended that each ITE/TE program conduct and maintain careful records of a follow-up of its students. Such a study should record:

- Data descriptive of the students flowing through the program, e.g., age, sex, GPA, socio-economic class, aspirations, educational plans, test scores and the like.
- Data showing what kind of educational experience students had after participating in the ITE/TE program.
- Data showing what kind of work experiences they had during and after participating in the ITE/TE program.
- Similar data for comparable students **without** ITE/TE program experiences.

To conduct follow-up evaluations, the ITE/TE instructor typically tracks students who have participated in ITE/TE—for several years after they have done so. Typical follow-up intervals are 1 year, 3 year and 5 years after ITE/TE. In order for such evaluations to succeed the school must keep careful enrollment and address records both while the students are in school and for at least 5 years after they graduate or leave.

Typically, because of costs and the work involved, one samples the students who have taken ITE/TE rather than surveying all of them. The actual survey method could be:

- Telephone interview
- Mail survey
- In-person interview (at home)

The following represents some typical questions that may be posed in various ways in a follow-up survey. Figure VIII-5 shows a sample layout of such an instrument.

- What do ITE/TE students think of the program? Did students enjoy ITE/TE?
- How useful was the ITE/TE program in developing career and technology awareness?
- Did ITE/TE enhance their understanding of science and technology?
- What courses were taken after ITE/TE?
- How useful was ITE/TE in securing a job?
- Was ITE/TE helpful in identifying and preparing for advanced vocational-technical education?
- Did ITE/TE help them with consumer decisions?

Figure VIII-5

Program Follow-up Form[1]

My date of program completion or graduation was: ______________________

The ITE/TE Course(s) that I participated in was (were): ______________________

Please complete each item, using the 7-point rating scale. Choose the number that most closely reflects your opinion and write it in the box to the right of the item, as in the following example:

Vitamin C is: very beneficial 1 2 3 4 5 6 7 not at all beneficial
(Note: A rating of 3 indicates that vitamin C is thought to be only a little beneficial.)

1. My experience in ITE/TE was:	very satisfying	1 2 3 4 5 6 7	not at all satisfying
2. If I could choose courses again I would:	choose ITE/TE courses	1 2 3 4 5 6 7	not choose ITE/TE courses
3. My occupational/educational plans for the future are to:	enter (or stay in) an area of ITE/TE	1 2 3 4 5 6 7	not enter (or stay in) an area of ITE/TE

Questions 4-6 are similar **but they are not identical**. Please be sure to **answer all three questions**.

4. Which of the following best describes your present situation?
   1. employed full-time (35 hours or more per week)
   2. unemployed, or employed part-time, but seeking full-time employment
   3. full-time student
   4. none of the above
5. Which of the following best describes your present situation?
   1. employed full-time in an area of industrial technology.
   2. unemployed, or employed full-time or part-time, but seeking full-time employment in an area of industrial technology
   3. full-time student
   4. none of the above
6. Which of the following best describes your present situation?
   1. employed full-time in an area of industrial technology
   2. employed full-time in an area related to industrial technology
   3. employed full-time in an area unrelated to industrial technology
   4. employed full-time or part-time, but seeking employment in industrial technology
   5. unemployed, but seeking employment in industrial technology
   6. full-time student
   7. none of the above

Please provide any other comments that will help us improve the quality of our ITE/TE program, for example, What experiences in ITE were the most beneficial for you in your job? (if employed) What experiences were the least beneficial?

---

[1] Adapted from Pautler, 1977, p. 8-9.

Missouri School Classification and Accreditation[1]

The basic objective of the classification and accreditation program, which will be phased out by 1994 and replaced with the Missouri School Improvement Program, is to recognize educational resources and provide direction and assistance in the development of quality programs in the public schools (p. 2). Figure VIII-6 highlights some key provisions of this program.

Figure VIII-6

Overview of Missouri School Improvement Program[2]

> The Missouri School Improvement Program is designed to promote excellence in the public schools of the state. The State of Missouri has a dual responsibility for the quality of education provided its citizens. First it must ensure that all schools meet certain basic standards. Second it has a responsibility to see that the schools continue to strive for excellence in an increasingly competitive world. The Missouri School Improvement Program incorporates these two responsibilities (p. 7)...
>
> The assessment process is a combination of periodic, in-depth site reviews and the annual monitoring of critical indicators. (p. 4)
>
> The standards are organized in three sections, Resource Standards, Process Standards and Performance Standards. In general, the Resource Standards are concerned with the basic requirements that all districts must meet. These are generally quantitative in nature. Some standards are appropriate for all districts...other standards, such as those that deal with curriculum offerings need to be tailored for districts in different contextual settings. Here, multiple criteria are used comparing the district with "minimums" determined by the state, "norms" for districts of similar size and what is deemed "desirable" as determined by research and/or professional judgment. (p. 7)
>
> The Process Standards are concerned more with the qualitative dimension of schooling and include standards on Curriculum and Instruction, Instructional Climate, Learning Resources, Guidance and Counseling, Professional Development, Special Programs, Governance and Administration, Facilities, Safety and Support Services. Each of the process standards incorporates multiple criteria and cannot be easily quantified. Therefore, assessment of the Process Standards is accomplished through an on-site review by a team of trained observers.
>
> Performance Standards include three sets of indicators which are applied to all schools and a series of optional indicators among which districts can choose. The standards against which all school districts will be assessed include student achievement, drop-out rates and student follow-up. Information on these three sets of indicators is collected annually and analyzed as a part of the ongoing monitoring of school district quality. Districts will select additional performance indicators that apply to their school. (p. 7)
>
> Formal implementation of the Missouri School Improvement Plan will begin the Fall of 1990. The Missouri School Improvement Standards will be in effect for all districts at this time. However, ...it will be five years before all districts will have gone through the new quality assessment process. (p. 6)

---

[1] All content in this section cited from MODESE's *Handbook for Classification....*

[2] Overview of standards and procedures, 1990.

This program involves annual monitoring of critical indicators and on-site reviews, the latter conducted by a team of MO DESE, school, and university personnel. Prior to the on-site review, the school's teachers respond to a set of advance questions in the areas of:

- Curriculum development and implementation
- Instructional climate
- Learning resource centers
- Guidance and counseling
- Professional development
- Supplemental program
- Governance and administration
- Facilities and safety
- Support services

As with all professional evaluations, there is no need for anxiety in addressing the questions/issues. It is always best to respond openly and honestly—after all—who is better equipped to provide an insightful assessment of a school's functioning than its professional staff?

After the school has prepared all of the materials for the MO School Improvement program, an on site review will occur. This review will include careful procedures to ascertain and validate the extent to which the school meets the various standards. ITE teachers in particular will want to be prepared for the teacher interview should they be sampled. Figure VIII-7 summarizes the nature of this interview.

Figure VIII-7
MO School Improvement Program
Teacher Onsite Interview Guide

2.1 **Curriculum Development/Implementation** - Do you have curriculum guides and how do you use these? How do the teachers ensure continuity of learning from one grade level to the next? How do you share instructional objectives with parents and students?

2.2 **Instruction** - What types of instructional strategies do you use in the classroom? What instructional activities do you use to help students achieve success? How do you monitor student progress and inform parents of student progress? do you get information regularly about the progress of students in their previous classes? How do you use this information? How do you work with special service teachers to ensure student success?

2.3 **Assessment** - Describe what use you make of district testing and assessment data. What adjustments do you make in your classroom instruction or activities as a result of this data?

Figure VIII-7

MO School Improvement Program

Teacher Onsite Interview Guide (continued)

2.4 **Learning/Instructional Support** - Do you have materials for your class? Are these "quality" materials? Do you have the necessary supplemental materials (i.e., maps, charts, manipulatives, instructional equipment, etc.)? Discuss you role in the selection/replacement of instructional materials and supplies.

3. **Instructional Climate** - Discuss the discipline in your building. How is instructional time protected? How are student and staff accomplishments recognized? How are staff, parents, and students provided input into the decision-making process? (Look for evidence concerning the quality of staff/student relationships, display of student work, orderliness in building, interruptions of instructional time, e.g., tardiness, excessive use of P.A. system recognition, of student/staff work).

4. **Learning Resource Centers** - To what extent do you use library resources in your instructional program? What input do you have in the selection of library resources and materials? How do your students learn library skills? Are LRC's open and available before and after school?

5. **Guidance and Counseling Programs** - What types of classroom and group guidance activities are provided in your building? How are you students being helped in their personal, education, and career planning/ Have you been involved in consultation activities with counselors concerning student progress and behavior? What role do teacher play in providing or requesting these services?

6. **Professional Development** - What kinds of professional development activities have YOU participated in recently? How has it helped you? Has the Performance Based Evaluation process helped you improve your skills as a teacher?

7. **Supplemental Programs** - What programs and activities available in you building seem especially helpful to students?

8. **Facilities** - What are the strengths and/or inadequacies of the building/facilities which impact on you classroom activities? (Note observations of building/facilities during your site visit).

Strengths - of your program - building -district:

Recommendations for improvement of your program - building - district:

Throughout the process, various standards will be applied. Figure VIII-8 abstracts some of the resource and process standards which are particularly relevant to ITE/TE. Teachers are encouraged to consult the complete listings of standards and indicators in the MO DESE documents cited in this chapter's resource section (part 4). It is also recommended that ITE teachers use and refer to the MO ITE standards included throughout this guide and also available from Missouri's State Supervisor of ITE. These professionally developed standards provide the discipline, specificity, criteria and detail that no overall listing can attain.

Figure VIII-8

Missouri School Improvement Program Standards

Resource Standards

1 4 Junior High/Middle (Grades 5-9) - Language arts, mathematics, science and social studies shall be scheduled and taught for at least 900 minutes per week in the aggregate.

Physical education, health (including drug and alcohol abuse prevention education and AIDS prevention education) and safety education shall be taught to all students at all grade levels in one of the following arrangements:

a. Physical education at least 2 periods per week; health/safety at least 1 period per week.

b. Physical education and health/safety combined at least 3 periods a week.

c. Physical education at least 2 periods per week; health/safety clearly and identifiably taught in other required courses.

d. The equivalent of one of the three above options adjusted to allow for block or semester scheduling.

Art and music shall be taught and scheduled so that all students have access to them for a minimum of 1,500 minutes per year.

At least 4 additional courses shall be available (e.g. speech, agriculture, home economics, industrial technology, foreign language, computer literacy, developmental reading) based on students' needs and interests. Each class shall be taught for a minimum of 900 minutes per year.

Each student in seventh grade or above receives instruction in the United States and Missouri Constitutions, history and institutions as required by section 170.011, RSMo.

Figure VIII-8

Missouri School Improvement Program Standards (continued)

Resource Standards

I .5 High School - Each high school shall have a current minimum offering of 40.5 units of credit with sufficient sections in each subject and course to meet the needs of all students in grades 9-12 and to be distributed as follows:

	MINIMUM STANDARD	DESIRABLE STANDARD
English/Language Arts/Communication	6	10
Foreign Language (must include 2 units of one language)	2	4
Social Studies (Minimum must include 1 unit each of American History and World History, 1/2 unit or equivalent of government; Desirable must also include 1/2 unit geography)	5	6
Mathematics (Minimum must include Algebra I and 2 units from Algebra II, Geometry, Trigonometry, Calculus and Math Analysis; Desirable must include 3 units from above list)	4	7
Science (Must include Biology, Chemistry and Physics)	4	6
Fine Arts (Must include both Art and Music)	2	6
Vocational Education (Must include a broad range of offerings that lead to employment or related post-secondary education and are based on students' needs and interests. Four occupational program areas must be offered.)	12	20
Physical Education	1	2
Health	0.5	1

Figure VIII-8

Missouri School Improvement Program Standards (continued)

Resource Standards (continued)

Practical Arts (includes courses other than those defined as vocational education and nonvocational courses which provide practical experiences for students; e.g. Driver Education; Computer Literacy)	4	8
TOTAL	40.5	69

For purposes of counting credit under this standard, repetitive classes such as Band, Chorus, Glee Club and Physical Education (unless clearly differentiated) will count as one (l) unit of offerings.

Process Standards

LEARNING/INSTRUCTIONAL RESOURCES

2.4A Each staff member and student has access to resources of the type and in the quantity needed to implement the curriculum of the school effectively.

2.4B Instructional apparatus and equipment in all laboratories, resource centers and classrooms are maintained in good working condition.

2.4 C Facilities and apparatus are equipped with all necessary emergency and safety devices, and staff are trained in their safe and appropriate use.

PROFESSIONAL DEVELOPMENT

Continuous professional growth and development is a vital component of maintaining a well qualified staff who are receptive to new ideas current with developments in education and constantly striving to improve instructional effectiveness.

6.1 A For the entire school staff, professional growth is a continuous process of refining skills and keeping current with new developments in the field of education.

6.1 B Professional development programs are cooperatively developed by the school staff, administrators, and school board members with assistance from a professional development committee, as required by Section 168.400 RSMo.

Figure VIII-8

Missouri School Improvement Program Standards (continued)

Process Standards (continued)

6.1 C Professional development opportunities are available for all staff and supported financially to the extent necessary to enable participation.

6.1 D Special attention is given to beginning staff members through special assistance and mentoring arrangements.

6.1 E Procedures exist which promote and encourage attendance at workshops, conferences, and other professional development activities.

FACILITIES

Facilities that are properly maintained and appropriate to the educational purposes and programs.all.help to establish an educational environment that is conducive to maximum learning effectiveness.

9.1 A Facilities arc clean, attractive, safe, healthful, adequately, and appropriate to house the educational programs of the district.

9.1 B The facilities are accessible, accommodate all populations, and are available for community use in accordance with board policy.

9.1 C The board has a written long-range plan for the maintenance and/or renovation of facilities and for construction of new facilities to meet the educational needs of the district.

SAFETY

The board of education and the staff have substantial responsibility for routinely monitoring all operations of the school to ensure student and staff safety and to take remedial action when unsafe conditions are present.

10.1A The board has designated a safety coordinator who is responsible for monitoring all aspects of safety.

10.1B All facilities and equipment are regularly examined for safety hazards and repairs.

10.1C The district has developed emergency procedures and conducts drills with plans cooperatively developed with local emergency agencies.

Using the MO ITE Standards

The ITE/TE profession's national and state leaders have produced standards (a sample is shown in Figure VIII-2) for the program. Properly used, they will yield a valid indication of the quality of a program. These standards are distributed throughout this guide and they also may be obtained from the Missouri State of ITE supervisor.

Developing the Overall Profile[1]

Whoever is conducting the ITE/TE program, or program component, assessment must come to a decision whether each standard in each topic has been met, was exceeded, is deficient, or is not applicable. These decisions may be made either individually or by a team. If the standard was not met, the inverted triangle is shaded. If the standard was exceeded, the upright triangle is shaded, and if the standard was met but not exceeded, the central oval is to be shaded. No discussion is necessary at this time. A quick decision should be made regarding each statement and comment. If in a team situation, it is recommended that discussion should be used only if the comments and judgments are divergent or are in error. This entire process should last only 45 minutes for each of the ten standard topics.

One of the most difficult tasks in using the standards is to develop the means by which the identified deficiencies are to be corrected.

After each standard in the topic is completed a summary for that topic is generated. The results of these summaries are transferred to the ITE/TE Program Overall Quality profile sheet as shown in Figure VIII-9. The profile,provides a visual format to illustrate the extent to which the program meets the standards. The profile can be used for presentations to the advisory council, teachers, the school administration, and the Board of Education. As deficiencies are corrected, the profile can be adjusted to show progress.

Identifying Means to Correct Deficiencies[1]

One of the most difficult tasks in using the standards is to develop the means by which the identified deficiencies are to be corrected. To develop a deficiency correction report for each standard statement which is below standard is a time consuming and arduous endeavor. Therefore, it is recommended that whenever possible standard topics and sub-topics be grouped together into a single deficiency correction report. This will reduce the effort required and it groups together a common set of tasks to overcome related deficiencies. This method will also provide long-range and short-range goals to be undertaken to alleviate the deficiency.

A deficiency correction report, a sample is provided in Figure VIII-10, is a plan for overcoming the deficiency. As such it should be written in behavioral terms. Several short-term and long-term goals should be identified with specific target dates given for each goal. It is also very important to specify who is to do the work required. Each goal and respective target date will be used to formulate the plan of action.

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[1] Adapted with permission from Walencik, Vincent J. *User's Manual: Standards for Industrial Arts in New Jersey.*

This plan must also include specific cost estimates for the work needed to overcome each deficiency. The deficiency correction report then includes:

- The topic and standards which need attention.
- The goals, stated in behavioral terms, that are appropriate to address the weaknesses and that specify:
    - an observable outcome
    - conditions of performance
    - criteria for judging success
- A plan of action for addressing the weaknesses. This plan includes:
    - who is to do the work
    - task(s) to be accomplished
    - timelines to be met
    - resources to be allocated
- Administrative approval

Such a systematic approach is realistic and will be appreciated by the Board of Education and school administration. It is recommended that outside consultants who are familiar with contemporary national and state trends in industrial technology education/industrial arts be employed to assist in the activity towards correcting key deficiencies.

Figure VIII-9

Industrial Technology Education Program Overall Quality Profile

Record each standard topic's count of standards met and exceeded in its bar chart.

Standard Topic 1: **Philosophy** (Chapter 1)

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		8.5		17

Standard Topic 2: **Instructional Program** (Chapter 2)

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		14.5		29

Standard Topic 3: **Student Populations Served** (Chapter 2)

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		5.5		11

Standard Topic 4: **Instructional Staff** (Chapter 9)

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		10		20

Standard Topic 5: **Administration and Supervision** (Chapter 7)

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		14		28

Standard Topic 6: **Support Systems** (Chapter 7)

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		15		30

Standard Topic 7: **Instructional Strategies** (Chapter 6)

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		9.5		19

Standard Topic 8: **Public Relations** (Chapter 5)

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		5.5		11

Standard Topic 9: **Safety and Health** (Chapter 4)

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		23.5		47

Standard Topic 10: **Evaluation Process** (Chapter 8)

Percent Achieved	0%	25%	50%	75%	100%
Standards Met/Exceeded	0		4.5		9

Figure VIII-10

Deficiency Correction Report

School: ____________________ Reported by: ________________ Date: _____

Topic: _________________________ Page No.: __________ Standard No: ___

Statement of Deficiency:

Priority for Correction: High Medium Low (circle one)

Person(s) Responsible for Correcting Deficiency: ____________________________

Plan for Overcoming Deficiency:

Resources Required:

Estimated Cost $_____________

Estimated Completion Date: ___________ Date Standard Met: _________

3. Evaluating ITE/TE Teacher Effectiveness

Invariably ITE/TE instructors will find their own performance being evaluated—both formally and informally. It will be important to insure that the formal process documents the quality of their performance in such a manner that ad hoc and/or ill-informed informal judgements do not jeopardize one's chances for tenure and/or merit raises. ITE/TE instructors will typically find themselves evaluated on a wide range of criteria. Usually they include:

- Instructional effectiveness
- Facility management
- The extent to which one contributes to the school
- Motivational ability
- Overall program quality

It is recommended that ITE/TE instructors deliberately seek formal supervisor and administrator evaluations each year. It is important that such evaluations are carefully done, that they represent an effort commensurate with the importance of instructor evaluation and that they highlight the instructor's strengths and weaknesses. Then, it is vital that all identified weaknesses also are accompanied by a list of recommended actions that could eliminate the weaknesses. As Missouri moves towards more accountability it will be important to keep careful records of such evaluations and to systematically document all progress towards improvement.

> **It is recommended that ITE/TE instructors deliberately seek formal supervisor and administrator evaluations each year.**

As with program evaluation, it is thought that the most effective (in terms of promoting improvement) form of evaluation is self-evaluation. Individual ITE/TE instructors might well wish to consider how well their teaching meets the criteria set out in the Texas *Industrial Technology Curriculum Guide* (p. 279, 280):

1. "There is a definitive statement of goals to be achieved.
2. The instructional program developed out of a direct concern for the most appropriate methodology to accomplish a given goal.
3. The methodology takes into account the learning and performance needs of the learner with respect to the goal(s) to be accomplished.
4. The goals of the experience are understood by the student and the teacher.
5. The goals are realistic in terms of the student's capabilities, program time limitations, physical facilities, teacher competencies and methodological considerations.
6. More important goals should receive greater consideration in weight in evaluation than less important goal.
7. The instructional procedures are selected to provide for the greatest degree of student involvement with the subject matter."

Perhaps one of the more effective ways to evaluate one's teaching performance is to have a respected colleague sit in during several of your classes. Thereafter, ask him/her to critique what they observed. It is often useful to have this done by both other ITE/TE instructors and also by non-ITE/TE teachers. Both can yield unique and valuable perspectives. Instructors may also find it useful to videotape their lesson and then analyze what they see themselves. Figure VIII-11 presents an analysis and rating sheet useful to external evaluation as well as for self-evaluation.

Figure VIII-11
Lesson Presentation Evaluation Sheet

Teacher ______________________________ Date ________________

Subject Area ______________________________ Grade __________ Visit No. __

Title of lesson ____

Lesson Type: Lecture_____ Demonstration_____ Video-tape Number____ Counter_____ - _____

Rating scale: E = Excellent = 3 A = Average = 2
W = Weak = 1 U = Unsatisfactory = 0

1. Lesson objective(s) was made known to the student. 0 1 2 3
2. Lesson introduction established a feeling of need and created interest. 0 1 2 3
3. All needed supplementary teaching/learning items were ready. 0 1 2 3
4. Appropriate information assignments (text, reference books, information sheets, etc.) were given. 0 1 2 3
5. Instructor maintained proper position for all students to see and hear. 0 1 2 3
6. Instructor talked to the class, not to the tools or materials. 0 1 2 3
7. Sufficient use was made of supplementary teaching items. 0 1 2 3
8. Vocabulary was appropriate. 0 1 2 3
9. Interaction items were asked at proper checking points. 0 1 2 3
10. A. Lesson followed topical outlines. 0 1 2 3
    B. Demonstration - one idea was presented at a time and tied to the next. 0 1 2 3
11. Appropriate teaching method(s) selected to accomplish objectives. 0 1 2 3
12. Instructor displayed a high degree of skill. 0 1 2 3
13. Instructor maintained poise throughout. 0 1 2 3
14. Instructor stayed on the subject. 0 1 2 3
15. Safety precautions were stressed. 0 1 2 3
16. Lesson length fits content. 0 1 2 3
17. Summation and closure were established. 0 1 2 3
18. Follow-up activities designed for immediate applications were provided for. 0 1 2 3
19. Unit test items were prepared. 0 1 2 3
20. Instructor followed written lesson plan. 0 1 2 3

Assessment Scale: Excellent = 54-60, Average = 48-53,
Weak = 40-47, Unsatisfactory < = 40

Total = ___________

Performance-Based Evaluation

Missouri's legislature in 1983 created a law (section 168.128) detailing the requirements for teacher evaluation. A the relevant section is quoted in *Guidelines for Performance Based Teacher Evaluation in Missouri*, a publication available from the Missouri DESE. This document also highlights the background, philosophy and procedures of the recommended teacher evaluation process. Essentially it states that:

> **Missouri's legislature in 1983 created a law (section 168.128) detailing the requirements for teacher evaluation.**

- The principal is responsible for the performance-based teacher evaluation system.
- Performance-based teacher evaluation systems should include a **formative** evaluation phase. The formative phase should include both scheduled and unscheduled classroom observations. A pre-observation conference should occur prior to scheduled observations. Formative evaluation includes the classroom observations designed to help teachers improve their performance by providing feedback and suggestions regarding their teaching skills.
- The summative phase of the evaluation process is a composite of information obtained through the formative observations and may serve as the basis for administrative decision making. A summative evaluation should be completed for a probationary teacher each year. For tenured teachers, a summative evaluation should be completed at least once every three years or as necessary to best serve the instructional process.
- A post-observation conference should be conducted within a reasonable period of time following each classroom observation. This conference should include a discussion of identified strengths and weaknesses. Job targets for maintaining and improving teacher performance should be completed for a probationary teacher each year.
- The evaluation system should include an appeal process defined within local school district policy.

Figure VIII-12 presents 19 criteria suggested for performance based teacher evaluation systems. The original document then provides useful descriptions for each of these criteria. Figures VIII-13 to VIII-16 present Missouri's recommended worksheets useful for the formative and summative parts of the process.

It is important for the ITE/TE instructor to point out to his/her administrator the differences in operating a laboratory-based program from one that is conducted in a typical "normal" classroom. Perhaps the best way to address these differences is to **weight** the performance criteria used for ITE/TE instructors differently than those used for "classroom" teachers. It would seem, for example, that since the Classroom Management criteria shown in Figure VIII-12 are particularly more significant to the success of ITE/TE it would be appropriate to weight them more heavily.

Figure VIII-15 then presents the results in terms of a job target sheet. This is intended to clarify improvements that would enhance the teacher's effectiveness, the procedures to achieve the improvement, the approval methods to be used to measure achievement and the timelines for accomplishment of the goals.

Figure VIII-16 is the recommended summative evaluation form that assesses teacher performance against the criteria in terms of performance levels. Furthermore it highlights what is considered desirable (performance expectations) and it identifies how one might exceed these expectations.

Figure VIII-12

19 Suggested Criteria for Performance-Based Teacher Evaluation[1]

I. Instructional Process

The Teacher:
- A. Demonstrates appropriate preparation for classroom instruction.
- B. Implements a variety of effective teaching techniques.
- C. Provides opportunities for individual differences.
- D. Implements instructional objectives effectively.
- E. Demonstrates a knowledge of subject matters.
- F. Uses a variety of teaching materials effectively.
- G. Uses instructional time effectively.
- H. Demonstrates ability to motivate students.
- I. Demonstrates ability to communicate effectively with students.
- J. Provides students with specific evaluative feedback.

II. Classroom Management

The Teacher:
- A. Organizes classroom environment to promote learning
- B. Manages student behavior in a constructive manner.

III. Interpersonal Relationships

The Teacher:
- A. Demonstrates positive interpersonal relations with students.
- B. Demonstrates positive interpersonal relations with parents/patrons.
- C. Demonstrates positive interpersonal relations with education staff.

IV. Professional Responsibilities

The Teacher:
- A. Participates in professional growth activities.
- B. Follows the policies and procedures of the school district.
- C. Assumes responsibilities outside of the classroom as they relate to the school.
- D. Demonstrates a sense of professional responsibility.

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[1] *Guidelines for Performance Based Teacher Evaluation in Missouri*, 1984.

Figure VIII-13

Pre-Observation Worksheet[1]

Teacher	Date	School
Subject	Grade	Period/Time

Teacher completes this form and discusses content with administrator prior to scheduled observation.

1. What are the lesson objectives?	2. Which of the steps of the teaching act will take place? ____ Develop anticipatory set ____ State objectives, why they are needed ____ Provide input ____ Model ideal behavior ____ Check for comprehension ____ Provide guided practice ____ Provide independent practice ____ Achieve closure
3. What teaching/learning activities will take place?	4. How are you going to check student understanding and mastery of the lesson objectives?
5. What particular teaching behaviors do you especially want monitored?	6. Are there any special circumstances of which the evaluator should be aware?
NOTES:	NOTES:

Teacher/s Signature/Date	Evaluator's Signature/Date

(Signatures simply imply that information has been discussed)

---

[1] *Guidelines for Performance Based Teacher Evaluation in Missouri*, 1984.

Figure VIII-14

Formative Observation Form[1]

Teacher	Date	School
Subject	Grade	Period/Time

1. **Instructional Process Characteristics**
   - a. Establishes set
   - b. States objectives
   - c. Provides input
   - d. Models ideal behavior
   - e. Checks for comprehension
   - f. Provides guided practice
   - g. Provides independent practice
   - h. Achieves closure
2. **Performance Criteria**
   - a. Demonstrates appropriate preparation for classroom instruction.
   - b. Implements a variety of effective teaching techniques.
   - c. Provides opportunities for individual differences.
   - d. Implements instructional objectives effectively.
   - e. Demonstrates a knowledge of subject matter.
   - f. Uses a variety of teaching materials effectively.
   - g. Uses instructional time effectively.
   - h. Demonstrates ability to motivate students.
   - i. Demonstrates ability to communicate effectively with students.
   - j. Provides students with specific evaluative feedback.
   - k. Organizes classroom environment to promote learning.
   - l. Manages student behavior in a constructive manner.
   - m. Demonstrates positive interpersonal relationships with students.

COMMENTS:

COMMENTS:

Teacher's Signature

Evaluator's Signature

(Signatures simply imply that information has been discussed.)

---

[1] *Guidelines for Performance Based Teacher Evaluation in Missouri*, 1984.

Figure VIII-15

Job Target Sheet[1]

Teacher ____________ Date ____________ School ____________

1. Performance Area:
2. Criterion*:
3. Improvement Objective(s): (Applicable descriptors and/or definable deficiencies)
4. Procedures for Achieving Objective(s): (Explanation of teacher & administrator responsibilities)
5. Appraisal Method and Target Dates:
6. Teacher's Comments:
7. Evaluator Comments:

Teacher's Signature ____________ Evaluator's Signature/Date ____________

Date Objective Achieved: ____________

Evaluator's Signature ____________

Instructor's Signature ____________

(Signatures simply imply that information has been discussed)
*One Job Target Sheet should be used for each criterion

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[1] *Guidelines for Performance Based Teacher Evaluation in Missouri*, 1984.

Figure VIII-16

Summative Evaluation Report[1]

Summative Evaluation Report		Teacher ______________		Date ___________	
Performance Area I: **The instructional process**					
Criteria **The teacher...**		**Performance Levels**		**PERFORMANCE EXPECTATION**	**In addition to performance expectation**
A. Demonstrates appropriate preparation for classroom instruction	Not observed A I	Does not prepare for classroom instruction	Sometimes prepares for classroom instruction	Consistently prepares for classroom instruction	Displays evidence of superior preparation for classroom instruction
B. Implements a variety of effective teaching techniques	Not observed A I	Shows little or no evidence of variety in teaching strategies	Intermittently uses variety in teaching strategies which are effective	Uses a variety of teaching strategies which are effective in achieving lesson objectives	Develops exceptional teaching strategies to meet individual needs
C. Provides opportunities for individual differences	Not observed A I	Does not provide for individual rates of learning and capabilities	Intermittently provide for individual rates of learning and capabilities	Provides for individual rates of learning and capabilities	Provides maximum instructional opportunities for individual learning styles
D. Implements instructional objectives effectively	Not observed A I	Shows little or no evidence of implementing instructional objectives	Intermittently Implements instructional objectives	Implements instructional objectives	Goes beyond the requirement of instructional objectives
E. Demonstrates a knowledge of subject matter	Not observed A I	Demonstrates an insufficient knowledge of subject matter	Demonstrates limited knowledge of subject matter	Demonstrates adequate knowledge of subject matter	Demonstrates superior knowledge of subject matter
F. Uses a variety of teaching materials	Not observed A I	Uses materials which are irrelevant to the instructional objectives	Intermittently uses materials which are irrelevant to the instructional objectives	Uses materials which are relevant and appropriate to the instructional objectives	Seeks out and/or develops a variety of creative materials appropriate to the instructional objectives
G. Uses instructional time effectively	Not observed A I	Shows little or no evidence of maintaining students on the learning task	Sometimes maintains students on the learning task	Maintains students on the learning task	Is extremely skillful in maintaining students on the learning task
H. Demonstrates ability to motivate students	Not observed A I	Shows little or no evidence of motivating students to perform to their abilities	Occasionally motivates students to perform assigned tasks, but inconsistently requires students to perform according to their abilities	Clearly expects and motivates students to perform assigned tasks to their abilities	Motivates students to achieve beyond previous performance levels
I. Demonstrates ability tp communicate effectively with students	Not observed A I	Does not communicate clearly; students often appear confused	Sometimes communicates clearly, but does not encourage student input	Communicates clearly and encourages relevant dialog	Is extremely skillful in using a variety of verbal and non-verbal communications
J. Provides students with specific evaluative feedback	Not observed A I	Gives no evaluative feedback	Is inconsistent in giving evaluative feedback	Gives specific evaluative feedback	Gives feedback with reinforcement and encouragement
Performance Area II: **Classroom Management**					
A. Organizes classroom environment to promote learning	Not observed A I	Displays little or no skill in organizing the classroom learning environment	Ineffectively manages the classroom learning environment; selects appropriate activities	Maintains a functional classroom learning environment; selects appropriate activities	Assesses and adjusts the setting to provide for a variety of learning styles
B. Manages student behavior in a constructive manner	Not observed A I	Shows little or no classroom control	Is inconsistent in controlling pupil behavior	Establishes and maintains effective discipline	Plans and implements strategies for pupil self-discipline

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[1] *Guidelines for Performance Based Teacher Evaluation in Missouri*, 1984.

Figure VIII-16

Summative Evaluation Report, continued

Performance Area III: **Interpersonal Relationships**					
Criteria The teacher...		**Performance Levels**		**PERFORMANCE EXPECTATION**	**In addition to performance expectation**
A. Demonstrates positive interpersonal relationships with students	Not observed A I	Is unresponsive to the needs of students	Intermittently shows sensitivity to the needs of students	Demonstrates sensitivity to all students	Willingly provides extra efforts to meet the needs of students
B. Demonstrates positive interpersonal relations with educational staff	Not observed A I	Shows little or no interest in interacting with educational staff	Intermittently shows interest in activities of educational staff	Works well with members of educational staff	provides leadership to promote a good working relationship with educational staff
C. Demonstrates positive interpersonal relations with the parents/patrons	Not observed A I	Shows little or no interest in interacting with parents/patrons	Intermittently shows interest in the activities and needs of the parents/patrons	Works well with parents/patrons	Provides active leadership to promote a good working relationship with parents/patrons
Performance Area IV: **Professional Responsibilities**					
A. Participates in professional growth activities	Not observed A I	Shows no interest in professional growth activities	Occasionally participates in professional growth activities	Seeks out and voluntarily participates in relevant professional growth activities	Initiates professional growth activities, encourages other staff to participate in professional growth activities
B. Follows the policies and procedures of the school district	Not observed A I	Does not comply with school and district regulations and policies	Intermittently complies with school and district regulations and policies	Fully complies with school and district regulations and policies	provides leadership in the development/ improvement of school and district regulations and policies
C. Assumes responsibilities outside of the classroom as they relate to school	Not observed A I	Does not assume out-of-class responsibilities	Intermittently assumes out-of-class responsibilities	Performs out-of-class responsibilities for smooth operation of the school	Is self-motivated, assumes extra responsibilities willingly
D. Demonstrates a sense of professional responsibility	Not observed A I	Does not fulfill directed school responsibilities	Needs to be reminded to meet directed school responsibilities	Fulfills directed school responsibilities	Is self-motivated, assumes extra responsibilities willingly

Comments

Comments

Teacher's Signature/Date

Evaluator's Signature/Date

(Signatures simply imply that information has been discussed)

4. Resources

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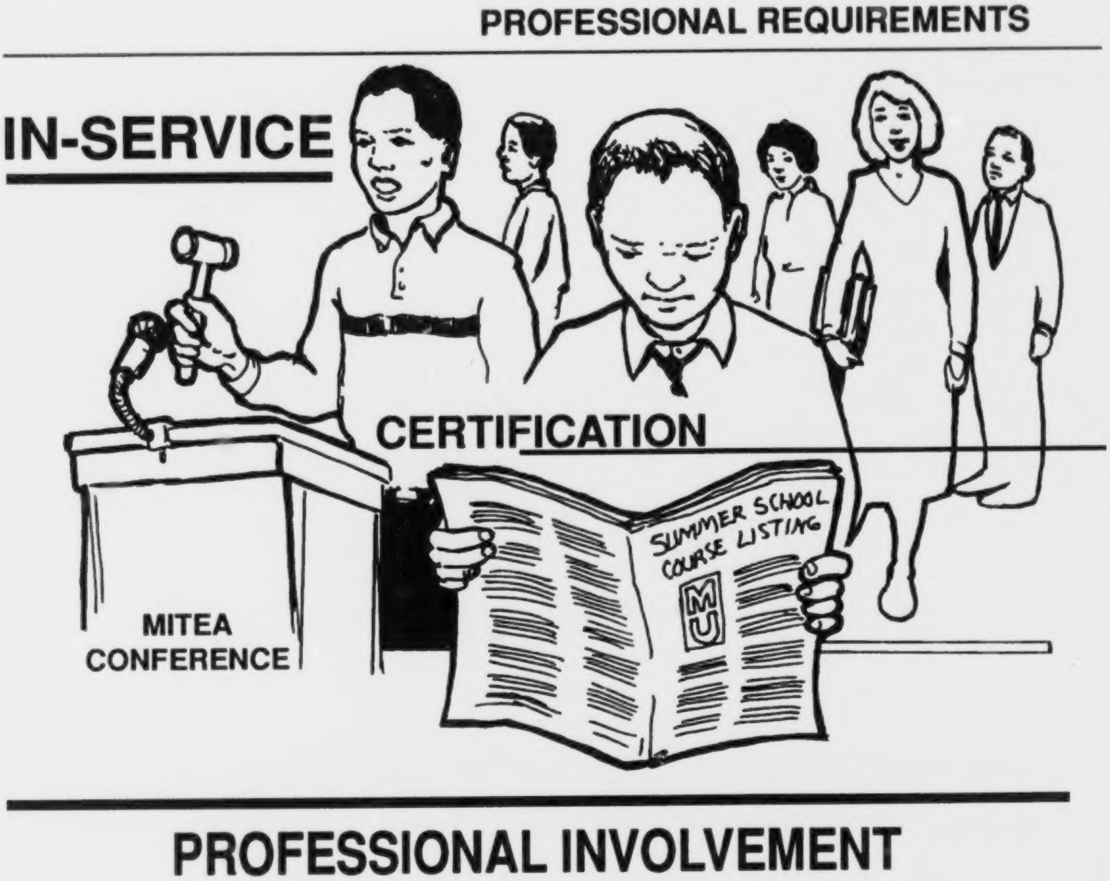
Notes:

CHAPTER IX

MEETING PROFESSIONAL RESPONSIBILITIES


PROFESSIONAL REQUIREMENTS
IN-SERVICE
CERTIFICATION
MITEA CONFERENCE
SUMMER SCHOOL COURSE LISTING
MU
PROFESSIONAL INVOLVEMENT

Chapter IX

Meeting Professional Responsibilities

1. Introduction & Overview

Overview

Be a professional. Industrial Technology/Technology Educators **are** professionals. There must be no doubt in the public's mind, and in the perception of our colleagues in education, that we Industrial Technology/Technology educators are members of the profession and that we belong!

This necessitates that we think and carry ourselves as professionals. To help us do this, this chapter highlights key responsibilities we must accept. Additionally the profession's ethical standards are presented as are the relevant points of pre- and in-service education. Finally, the chapter concludes with some suggestions for increasing our involvement with the larger profession—in our region, state and nation.

Objectives

1. To document a professional's responsibilities and promote ethical performance.
2. To describe preservice preparation and certification routes and requirements.
3. To encourage increased participation in inservice and professional development opportunities.
4. To promote increased involvement in professional associations.

Chapter 9 Outline

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2. **Addressing Professional Responsibilities** 1
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4. **Using Available Inservice Education** 13
5. **Increasing Professional Involvement** 14
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2. Addressing Professional Responsibilities

Responsibilities

Industrial Technology/Technology Educators (teachers and supervisors) have many overlapping areas of responsibility. The primary responsibilities are to **serve** youth, to be **effective** and to **participate** in the profession. Within these three primary charges lies the core of the teacher's responsibility and profession. Specifically, ITE/TE instructors are expected to:

- Manage the ITE/TE facility
- Prepare budgets and assist in the purchasing process
- Familiarize themselves with the characteristics of their students
- Concern themselves with student value systems
- Move students along at a pace commensurate with their talent
- Attend to the demands of individual differences and special needs
- Systematically assess, record and communicate student progress
- Control disbursement of consumable supplies
- Maintain appropriate discipline
- Impart knowledge, attitudes and skills consistent with the acknowledged goals of ITE/TE
- Develop courses of study
- Assess and further the efficiency and effectiveness of their instruction
- Establish and secure approval for ITE/TE policies
- Reward performance and motivate students towards it
- Supervise student laboratory activities
- Develop and/or select appropriate instructional materials
- Evaluate the ITE/TE program's effectiveness
- Keep current in their technological field
- Follow school policy
- Provide a safe facility and instruct to insure safe operation within it

The literature is full of long lists of duties that detail each of the teacher's major responsibilities. More important than memorizing these lists is that Industrial Technology/Technology educators **internalize** them. In other words, that they become an integral part of one's being. Some representative behaviors that would exemplify such internalization include:

- Annually participating in MITEA and MVA state conferences.
- Attending ITEA and/or AVA national conferences at least periodically (every 2-5 years)
- Actively looking for, and participating in, in-service opportunities each year.
- Evaluating one's performance systematically and on an ongoing basis.
- Developing and implementing personal and local ITE/TE program improvement plans.
- Sponsoring student organizations such as TSA.
- Effective management of the ITE/TE facility, equipment and supplies.
- Systematic documentation of the ITE/TE curriculum.
- Maintaining a high degree of accuracy in grading and performance records.

The primary responsibilities are to serve youth, to be effective and to participate in the profession.

- Emphasizing safety throughout the ITE/TE program.
- Attending to public relations for the ITE/TE program and school.
- Developing a long-range budget.
- Participating in extra-curricular activities.
- Using individualized instruction as appropriate.
- Maintaining effective discipline.
- Helping other teachers and participants in school and program activities.

ITE/TE instructors need to be realistically aware of how well they incorporate the above expectations into their daily routine. To do this the MO ITE Standard's Topic 4 (in Figure IX-1) provides a useful checklist. Standards not met should be reviewed carefully with the instructor's department chairperson and principal.

Figure IX-1

MOITE Standards, Topic 4: Instructional Staff

The instructional staff in technology education and/or industrial technology will need to constantly study the nature of society and engage regularly in renewal activities. The success of programs in technology and/or industrial technology education will depend on highly trained and qualified teachers. The statements contained within this standard topic concerns the instructional staff. The instructional staff is responsible for providing the essential components for a quality program. Staff members should meet the highest standards of professional and technical competence.

Fill in marks to indicate assessment: ∇ **not met,** 0 **met,** Δ **exceeded**

1. The industrial technology/technology education teacher possesses a minimum of a baccalaureate degree with a major in industrial technology/technology education from an accredited teacher education program. ∇ 0 Δ
2. The technology teacher is broadly prepared and certificated in the systems of communication, construction, manufacturing and transportation. ∇ 0 Δ
3. The industrial technology/technology education teacher is technically competent in the assigned teaching area(s). ∇ 0 Δ
4. The industrial technology/technology education teacher is prepared, through preservice/inservice education, to eliminate sex bias and sex-role stereotyping. ∇ 0 Δ
5. The industrial technology/technology education teacher is prepared, through preservice/inservice education, to provide experiences for students with special needs. ∇ 0 Δ
6. The industrial technology/technology education teacher is prepared, through preservice/inservice education, to organize and operate a local TSA chapter or local program student club. ∇ 0 Δ
7. The industrial technology/technology education teacher, through preservice/inservice education, has knowledge of the legal and liability requirements of classroom/laboratory operation. ∇ 0 Δ
8. The industrial technology/technology education teacher is a member of and actively participates in professional and technical organizations related to technology education/industrial technology. ∇ 0 Δ

Figure IX-1

MOITE Standards, Topic 4: Instructional Staff, continued

Fill in marks to indicate assessment: ∇ **not met,** 0 **met,** Δ **exceeded**

9. The industrial technology/technology education teacher has a professional development plan for maintaining and expanding professional and technical teaching competencies. .... ∇ 0 Δ
10. The industrial technology/technology education industrial technology/technology education teacher participates in a minimum of one technology related inservice activity annually. .... ∇ 0 Δ
11. The industrial technology/technology education teacher maintains current knowledge in the industrial technology/technology education field through activities such as reading professional and technical publications. .... ∇ 0 Δ
12. The industrial technology/technology education teacher serves as an active member of the school instructional staff, sharing in decision-making processes and participating in program promotion and staff development. .... ∇ 0 Δ
13. The industrial technology/technology education teacher plans and implements instruction in cooperation with counselors and other appropriate support personnel. .... ∇ 0 Δ
14. The industrial technology/technology education teacher has a positive attitude toward the teaching profession and demonstrates a concern for the advancement of technology/industrial technology education. .... ∇ 0 Δ
15. The industrial technology/technology education adheres to a written code of ethics related to the performance of professional teaching responsibilities. .... ∇ 0 Δ
16. The industrial technology/technology education industrial technology/technology education teacher demonstrates adequate and appropriate written and oral language skills. .... ∇ 0 Δ
17. The industrial technology/technology education teacher provides positive leadership in the classroom, the school, and the profession. .... ∇ 0 Δ
18. The industrial technology/technology education teacher adheres to acceptable school practices regarding personal appearance. .... ∇ 0 Δ
19. The industrial technology/technology education teacher exhibits good work habits such as safe practices, punctuality, neatness, and attendance that have a positive effect upon the educational environment. .... ∇ 0 Δ
20. The industrial technology/technology education teacher is sensitive to student needs, recognizes individual student abilities, and practices appropriate teaching methods that motivate students to maximum performance. .... ∇ 0 Δ

Number of the topic's standards that were not met (∇), met (0), and exceeded (Δ): — — —

But teachers are not alone in having responsibility pertaining to the education of youth. Increasingly education is being considered a partnership of parents, the community and schools. To this end the national PTA has adopted a position of importance (see Figure IX-2).

Ethics

Generally each profession has a code of ethics that governs behavior and teaching is not different. These codes help new teachers learn what is expected of them. They allow identification of inappropriate behavior, such as pirating of computer software, and they help communicate the profession's ideals to the public. The NEA has developed and maintained such a code for years. The code is both simple and powerful at the same time. It is presented in Figure IX-3.

Closer to home, the MSTA also developed a professional code of ethics. This code is shown in Figure IX-4. It is interesting to note that the NEA's code identifies many of the practices which educators should avoid while the MSTA's code speaks more positively towards the profession's ideals but with less detail. Finally, all ITE/TE professionals should know that the ITEA has developed a set of beliefs that document the profession's perspective. These are presented in Figure IX-5.

Figure IX-2

Individual and Organizational Rights and Responsibilities in the Education of Children[1]

The National PTA believes that the primary responsibility for the education of children lies with the family. Parental involvement begins before the child's birth and should continue until the child reaches adulthood. That involvement takes many forms, including the parent's shared responsibility in decisions about the child's education, as well as the parent's participation in organizations that reflect the community's collective aspirations for the education of all children.

A Parent's Responsibilities

The parent, as a role model and initial teacher, has a responsibility to:

- safeguard and nurture the physical, mental, social and spiritual education of the child;
- instill respect for self, for others and for learning;
- provide opportunities for interaction with other children and adults;
- lay the foundation for responsible citizenship;
- provide a home environment that encourages and sets an example for the child's commitment to learning;
- know, help and interact with the child's teachers and administrators;
- participate in the selection of responsible school board members.

A Parent's Rights

A parent has a right to have:

- clear, correct and complete information about the school and his/her individual child's progress;
- confidentiality of information about his/her individual child;
- clear understanding of the processes to gain access to the appropriate school officials, to participate in decisions that are made, and to appeal matters pertaining to his/her individual child

Parents and other adults function outside the sphere of their own family by joining with interested parents and others to affect the education of all children.

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[1] Position adopted by National PTA Board of Directors, June, 1986.

Figure IX-2, Continued

Individual and Organizational Rights and Responsibilities in the Education of Children

Organizational Responsibilities

The membership of the PTA has a responsibility to:

- protect access to a quality education for all children;
- seek information on policies, curriculum and laws that affect children;
- share accurate information with its membership and the school community;
- know, help and interact with teachers and administrators;
- be willing to accept responsibilities for the vitality of the PTA to assure an active PTA;
- work within the PTA and the school in a constructive manner with respect for democratic procedures and a tolerance for a diversity of opinions;
- work in partnership with school professionals to determine appropriate levels of program and services;
- participate in decisions affecting policies, rules and regulations

Organizational Rights

A PTA has the right to:

- function as an independent, non-partisan child advocacy group;
- seek enactment of policies and practices which protect children and youth;
- participate, within school board policy, in the setting of the school goals and assist in the review of teaching materials;
- participate in decisions affecting policies, rules and regulations;
- meet with appropriate school officials to discuss matters of mutual concern affecting all children

The National PTA supports the concept of public schools because PTA believes they provide a common experience to ensure a democratic society. Within the rights and responsibilities of individual parents and organizations, the National PTA believes options and alternatives within the public schools should ensure that:

- the community sustain a viable public school system;
- parents have the opportunity for involvement in their children's schools;
- appropriate transportation be provided for students to ensure equity;
- specialized schools provide for a fair selection process;
- standards governing school curricula, personnel and student performance provide access to equal opportunities for students;
- adequate and objective information be available to parents so that they can make informed decisions.

Figure IX-3

NEA Code of Ethics of the Education Profession[1]

Preamble

The educator, believing in the worth and dignity of each human being, recognizes the supreme importance of the pursuit of truth, devotion to excellence and the nature of democratic principles. Essential to these goals is the protection of freedom to learn and to teach and the guarantee of equal educational opportunity for all. The educator accepts the responsibility to adhere to the highest ethical standards.

The educator recognizes the magnitude of the responsibility inherent in the teaching process. The desire for the respect and confidence of one's colleagues, of students, of parents and of the members of the community provides incentive to attain and maintain the highest possible degree of ethical conduct. The *Code of Ethics of the Education Profession* indicates the aspiration of all educators and provides standards by which to judge conduct.

The remedies specified by the NEA and/or its affiliates for the violations of any provision of this *Code* shall be exclusive and no such provision shall be enforceable in any form other than one specifically designated by the NEA or its affiliates.

PRINCIPLE I

Commitment to the Student
The educator strives to help each student realize his or her potential as a worthy and effective member of society. The educator therefore works to stimulate the spirit of inquiry, the acquisition of knowledge and understanding, and the thoughtful formulation of worthy goals.

In fulfillment of the obligation to the student, the educator —

1. Shall not unreasonably restrain the student from independent action in the pursuit of learning.
2. Shall not unreasonably deny the student access to varying points of view.
3. Shall not deliberately suppress or distort subject matter relevant to the student's progress.
4. Shall make reasonable effort to protect the student from conditions harmful to learning or to health and safety.
5. Shall not intentionally expose the student to embarrassment or disparagement.
6. Shall not on the basis of race, color, creed, sex, national origin, marital status, political or religious beliefs, family, social or cultural background, or sexual orientation, unfairly —
   a. Exclude any student from participation in any program
   b. Deny benefits to any student
   c. Grant any advantage to any student
7. Shall not use professional relationships with students for private advantage.
8. Shall not disclose information about students obtained in the course of a professional service, unless disclosure serves a compelling professional purpose or is required by law.

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[1] Adopted by 1975 NEA Representative Assembly, in *NEA Handbook*, 1986.

Figure IX-3, Continued

NEA Code of Ethics of the Education Profession

PRINCIPLE II

Commitment to the Profession

The education profession is vested by the public with a trust and responsibility requiring the highest ideals of professional service.

In the belief that the quality of the services of the education profession directly influences the nation and its citizens, the educator shall exert every effort to raise professional standards, to promote a climate that encourages the exercise of professional judgment, to achieve conditions which attract persons worthy of the trust to careers in education, and to assist in preventing the practice of the profession by unqualified persons.

In fulfillment of the obligation to the profession, the educator—

1. Shall not in an application for a professional position deliberately make a false statement or fail to disclose a material fact related to competency and qualifications.
2. Shall not misrepresent his/her professional qualifications.
3. Shall not assist any entry into the profession of a person known to be unqualified in respect to character, education, or other relevant attribute.
4. Shall not knowingly make a false statement concerning the qualifications of a candidate for a professional position.
5. Shall not assist a noneducator in the unauthorized practice of teaching.
6. Shall not disclose information about colleagues obtained in the course of professional service unless disclosure serves a compelling professional purpose or is required by law.
7. Shall not knowingly make false or malicious statements about a colleague.
8. Shall not accept any gratuity, gift or favor that might impair or appear to influence professional decisions or action.

Figure IX-4

MSTA Code of Professional Ethics

Student

- We believe our first obligation is to the students entrusted to our care.
- We believe the purpose of education is to develop each individual for his/her fullest participation in the American democratic society, to pursue truth, and to seek excellence. We will accept the responsibility of taking the initiative to eliminate all barriers that prevent full access to this unique education for all.

Profession

- We believe that academic freedom is inherent in, and essential to, the teaching profession.
- We believe that, for students to learn, teachers must be free to teach.
- We believe every educator should have a broad general education, a depth of preparation in special areas and a mastery of knowledge and skills.
- We believe an educator should be endowed with a thorough understanding of professional ethics, should possess a zeal for continuous self-improvement and should be imbued with a sense of moral and professional responsibility.

Community

- We believe that every educator has a right and a responsibility to be an informed and active citizen.
- We believe that, if the school is to relate to the students, teachers must understand the community and the home environment of all students.
- We believe free public education is an integral part of the community it serves and we shall encourage the development of educational opportunities for all.
- We believe that the continuation of our free nation and its strength and well being are dependent on free public education.

Figure IX-5

ITEA[1] Statement of Beliefs

This We Believe

Technology Education:

Should be a part of the learning experiences of all students at all levels of grade and ability, in order that they may understand, function, and control their industrial/technological environment.

Requires the highest level of competence from its instructional staff. Teachers must possess creativity and ingenuity, enjoy working with people, and maintain a high degree of personal and professional integrity.

Uniquely contributes to students of all learning ability levels of both sexes and regardless of career choices. It provides equal opportunities for those of high or low economic status, and those who may choose a professional life or a future as an industrial worker. It's equally important to everyone as all members of society must learn to be aware of and learn effectively in tomorrow's technological society.

Fosters an awareness of industry and enterprise and their place in the world culture. It also provides opportunities for learners to discover their talents and abilities in the areas of technology and applied science in the world of industry.

Activities form a continuum with other visual and applied arts, ranging from the free expressive forms to the more exacting demands of machine tools and applied sciences.

Is an organization of subject matter which provides opportunities for experiences concerned with developing insights into technology, its evolution, utilization, and significance; and industry, its organization, personnel, systems, techniques, and products; and their social cultural impact.

Provides technical skills and knowledge basic to most occupations and professions. Technology Education enables the future scientist and engineer to solve technical problems, and the future craftsperson or technician to develop knowledge, skills and the ability to obtain technical information.

Provides wholesome changes in learners. These may take the form of a developed interest in the human-made world—its materials, products and processes. These changes may also involve self-evaluation of attitudes towards constructive work and how this work can be utilized for health and recreation, as well as economic value; they may involve the development of a favorable attitude toward creative thinking, and toward character improvement—knowing and making the most of one's environment.

Employs actual involvement of tools, machines and materials, which reinforces the written and spoken word. It enables all students to derive meaning from concrete experiences which aid in the understanding of abstract ideas and the development of concepts.

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[1] *International Technology Education Association, 1914 Association Drive, Reston, VA 22091*

3. *Securing Preservice Preparation and Teacher Certification*

As a minimum, ITE/TE teachers need to possess a valid Baccalaureate degree from an accredited university or college. Possession of such a degree is usually the basis for which ITE/TE certification is granted. Emergency and/or provisional and/or temporary certificates are not considered appropriate by the profession. Nor are trade & industrial or art certifications adequate to provide proper ITE/TE instruction.

In order to be properly hired as an ITE/TE teacher, individuals must have completed at least the minimum pre-service preparation required for state certification. In Missouri, as in most states, the certification process is actually a licensure activity. Individuals complete required courses at accredited colleges or universities in order to obtain a license to practice. A Bachelor of Science or Education degree, with specific requirements for preparation in one or more areas of industrial technology, is required in order to hold an ITE/TE teaching position in Missouri. Some universities/colleges may also provide a five-year program to such certification.

A Bachelor of Science or Education degree, with specific requirements for preparation in one or more areas of industrial technology, is required in order to hold an ITE/TE teaching position in Missouri.

The primary route to an ITE/TE teaching position is via an industrial arts/industrial technology education or technology education degree from an accredited institution. In Missouri these institutions are the University of Missouri-Columbia and most of the regional universities and state colleges, including the College of the Ozarks. Chapter VII's Table VII-1 of this *Guide* lists the names and addresses of these schools and the appropriate departments to contact for information. A national directory of IA/ITE/TE teacher education programs is available from the ITEA and another, the *Industrial Teacher Education Directory*, is available from the Council on Technology Teacher Education (c/o Dr. Ervin A. Dennis, Department of Industrial Technology, University of Northern Iowa, Cedar Falls, IA 50614; Phone 319:273-2753).

The exact course requirements for the ITE/TE degree vary somewhat at the various institutions but they all fall within the guidelines set by the Missouri DESE and the profession. Different levels of the ITE/TE program also require differing coursework as do differing concentrations within technology. Generally it is the case that the more areas (concentrations) and levels (K-9 or K-12) of certification an individual possesses the more opportunities they have for jobs and advancement within their current jobs. The Missouri DESE's Certification section should always be contacted directly for the most recent requirements. The current minimums established by the Missouri DESE are shown in Figure IX-6. It should be noted that these are minimums and that most teacher education programs deliberately exceed these state established minimums.

If ITE/TE/IA certification is held in another state, the Missouri DESE should be contacted regarding reciprocity. Often at least temporary certification is qualified for. Another reason for contacting DESE is to secure the current details on Missouri

Tuition Reimbursement Program. Funded by the state's concern for enhancing the quality of its education, this program reimburses teachers (pending good performance) for tuition costs of some (usually in major area certification) courses.

It is the teacher's responsibility to seek certification and re-certification when necessary. Superintendents, principals and faculty at the teacher education programs can and do assist their teachers in the process, but the responsibility ultimately rests on each individual teacher's shoulders.

Figure IX-6

Missouri Industrial Technology Education Teacher Certification Minimums[1]

	Semester Credit Hours Required To Teach In Grades	
Subjects Studied	7-12	K-9
Graphic Communications[2]	7	6
Energy and Power[2]	7	6
Industrial Materials Processes[2]	7	6
Organization and Administration of Industrial Technology Education	5	5
Teaching Elementary Industrial Arts	0	3
Electives[3]	10	0
TOTAL	36	26

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[1] *Secondary Certification Requirements*, MO DESE, Revised 1991.

[2] The profession's intent is to require a systematic development of capabilities in each system of technology (communication, energy & power, materials & processing). Narrow treatment of only single areas within a system of technology are not considered sufficient to meet certification intent.

[3] The intent is to build on systems study with advanced work in one or more of the systems of technology.

4. Using Available In-Service Education

In-service education is frequently referred to as professional development. This implies a process of keeping current within the profession. In the field of Industrial Technology/Technology this is a never ending process due to the nature of technology and education. Industrial Technology/Technology education is therefore, a continually changing field of study which demands constant updating of our knowledge and skills.

Industrial Technology/Technology education is therefore, a continually changing field of study which demands constant updating of our knowledge and skills.

The annual MVA and MITEA conferences are a particularly important updating mechanism. Each year these conferences include many useful sessions ranging from the dissemination of new products, out of state speakers, teacher-to-teacher workshops, and industry-sponsored hands-on sessions. Often pre- or post-conference workshops are offered to make attendance even more worthwhile. Additionally, the MODESE sponsors useful workshops throughout the state. Details and schedules are available each year from Missouri's Supervisor of ITE.

Several other types of in-service education are available: leadership development, subject matter expertise development and the pursuit of advanced degrees are but some of the more common types. All of these can be appropriate and should be considered for professional development and personal growth. Credit for these types of in-service training experiences should be approved **prior** to enrollment. In some districts continuing education units (CEU) are not accepted toward career ladder, certification renewal, or professional advancement.

The demand for currency within technology and one or more individual areas within it is only one of the reasons for in-service education. Another is to learn to teach more effectively. Courses offered by colleges and universities, and designed to improve teaching skills, are usually called professional education. Increasingly Missouri's higher education institutions are offering short-term workshops for technological and professional updating. ITE/TE instructors are encouraged to contact these institutions. Often the MITEA newsletter also carries information about in-service opportunities.

Current Missouri and district emphases on the career ladder and merit pay concepts are often coupled with school district requirements for continuing education to qualify for salary increases. In-service education seems to be an ongoing concern for all teachers because of this. Therefore, each teacher should work out a professional development plan for his/her continuing education. Preferably this should be created shortly after the teacher begins to work in the district and it should involve his/her supervisors. This plan should contain specific courses as well as a time line for their completion. If this procedure is followed, there will be fewer last minute course decisions and less "end-of-certification" cramming in order to qualify for renewal or doubt whether a course counts towards a pay raise.

Some of the best sources for technological updating are the industrial and professional associations. Groups such as the Society for Automotive Engineers, the American Welding Society and many others offer conferences and courses which disseminate a great deal of current technical information related to technology education. The *Encyclopedia of Associations*, often found at local public and university libraries will provide useful lists of such associations and their addresses. Additionally business and industry settings offer much potential for job shadowing and job switching.

Job shadowing is a technique used to refresh old knowledge and skills, as well as to build new ones. By following a competent professional through their daily duties one can learn a lot. However, this technique is of little value if it is not conducted with thorough planning and forethought. It must not be taken lightly and preferably it should run for an extended period of time. One afternoon of shadowing is of less value than a month.

Job switching is an interesting concept whereby an industry professional switches jobs with a teacher for a period of time. The length of time varies depending on the industry and the professional's position. It can, however, vary from a week to a full semester. This system carries with it an opportunity to be exposed to a different view of industry but it must be carefully established to insure that proper authorization has been secured.

Some of the best sources for technological updating are the industrial and professional associations.

5. *Increasing Professional Involvement*

To be professional means to be active, to participate in collegial activity, to be inquiring, to be committed. To what? To be committed to improving the practice of the profession—as **we** do it ourselves and as **others** do it.

One of the easiest ways to increase professional involvement is to join the local, state and national professional associations. But joining is insufficient by itself. One must **participate!** Volunteer for a committee assignment, submit an article outlining an especially effective practice of yours, go to a conference . . . Frankly, the list is endless.

What type of associations are there? Several that have relevance to ITE/TE. Their nature is different so look for a "best fit" that enables you to participate and make a contribution. The categories and some examples of such associations are:

- Trade Associations. One joins these primarily to get access to current technical information and resources pertinent to a specific aspect of industrial technology, e.g. American

One of the easiest ways to increase professional involvement is to join the local, state and national professional associations. But joining is insufficient by itself. One must participate!

Metals Association, American Welding Society.

- Professional Association (in field). These associations typically all trace back to either the AVA or the ITEA. They serve to share current issues, to help member professionals, to lobby for our profession and the like. Typically they exist in local/regional, state and national varieties. A list is provided in Figure IX-6. e.g., AVA, ITEA, MVA, MITEA.
- Student Associations (in field). Designed to help students (elementary, secondary or collegiate), these associations help build character, citizenship and develop leadership while at the same time they inject a good measure of "fun" into the process. Usually such associations are intended to be co-curricular in nature - i.e., they reinforce the curriculum, e.g., TSA, TECA.
- Representative Associations. These groups generally focus on improving education and the teacher's welfare. They serve as the teacher's prime advocate. They exist in local, regional, state and national versions. e.g., MNEA, MFT, MSTA.
- Honor Societies. These associations are designed to enhance the academic/scholarship ideals of the profession and to recognize exemplary service. e.g., Epsilon Pi Tau, Phi Delta Kappa.
- PTOs. These groups work to improve education by bringing parents, educators and the community together. e.g., local PTOs.

Contact Missouri's State Supervisor of ITE, and/or the IA/ITE/TE departments at the state's higher education institutions, for current addresses for these associations. The *Encyclopedia of Associations*, usually found in the reference section of local libraries, is another valuable source for these and many other addresses.

Figure IX-7

Selected Professional Associations[1]

AACD	American Association for Counseling and Development
AASA	American Association of School Administrators
ATEA	American Technical Education Association
AVA	American Vocational Association
AVEA	Adult Vocational Education Association
AVEPDA	American Vocational Education Personnel Development Association
AVERA	American Vocational Education Research Association
COE	Council for Occupational Education
CTEA	Council of Technology Education Associations
CTTE	Council on Technology Teacher Education
EEA-SHIP	Educational Exhibitors Association - SHIP
ITEA	International Technology Education Association
ITEA-CS	International Technology Education Association-Council of Supervisors
IVETA	International Vocational Education and Training Association
MAMST	Missouri Alliance for Mathematics, Science and Technology
MEA	Marketing Education Association
MFT	Missouri Federation of Teachers
MITEA	Missouri Industrial Technology Education Association
MNEA	Missouri National Education Association
MSBA	Missouri School Boards Association
MSTA	Missouri State Teachers' Association
MVA	Missouri Vocational Association
NAAVBAVE	National Associat'n for the Advancement of Black Americans in Vocational Education
NAIT	National Association for Industrial Technology
NAITTE	National Association of Industrial, Technical Teacher Educators
NALCDVE	National Association of Large City Directors of Vocational Education
NASCVE	National Association of State Councils of Vocational Education
NASDVE	National Association of State Directors of Vocational Education
NASNSA	National Association of Special Needs State Administrators
NATIE	National Association for Trade and Industrial Education
NATTS	National Association of Trade and Technical Schools
NAVESNP	National Association of Vocational Education Special Needs Personnel
NAVSNTE	National Association of Vocational Special Needs Teacher Educators
NAVTEC	National Association of Vocational Technical Education Communicators
NCCVSO	National Coordinating Council for Vocational Student Organizations
NCLA	National Council of Local Administrators
NETA	National Employment and Training Association
NSBA	National School Boards Association
PTA	Parent Teacher Association
TEAC	Technology Education Advisory Council
TECA	Technology Education Collegiate Association
TECC	Technology Education for Children Council
TED	Technology Education Division (of the AVA)
TSA	Technology Students Association
VEEC	VEEC - Vocational Education Equity Council

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[1] Basic descriptive information about these and other associations may be obtained from the *Encyclopedia of Associations.*

6. Resources

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CHAPTER X

Helpful Resources

RECOMMENDED COMPETENCIES
COMPETENCY ARTICULATION
TAM INDEX

FORMS

CORE COMPETENCIES

Chapter X

Helpful Resources

1. Introduction & Overview

Overview

This chapter consists of four sections. Part 2 indexes the forms found throughout this guide and it provides a place for forms not incorporated into other chapters of this guide. Part 3 indexes the state's available TAMS by technological system/cluster. Part 4 contains the Missouri Industrial Technology/Technology Education competencies presented in a graphic format that demonstrates within program and core competency articulation links. Part 5 presents a suggestion form which may be used to provide feedback for future revisions and updates of this *Guide*. Instructors are encouraged to use this form to enhance the *Guide's* value!

Objectives

1. To ease access to, and increase the utility of, this *ITE/TE Guide* and the available TAMS.
2. To document the relationships among, and progression through, Missouri's ITE/TE competencies.
3. To articulate Missouri's ITE/TE competencies to the state's core competencies (basic skills).
4. To promote ongoing enhancement of this guide.

Chapter 10 Outline

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4. **Recommended ITE/TE Competencies and Articulation Links............................8**
5. **Suggested Revision Form............79**

2. *Index of Forms*

It is recommended that the ITE/TE instructor file originals of the forms your school system uses regularly following this page. In this way all forms will be conveniently available. Also as Missouri's DESE, your system and/or the Missouri State Supervisor of ITEsupply additional forms, they should be filed here as well. Forms found in other chapters of this guide are indexed here for convenience.

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Forms Index

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Figure X-2

Weekly Instructional Plan

Course: ____________________
Grade: ___ **Period:** ___ **Section:** ___
____

Instructor: __________
____
____

Date/Day	Topic	Activities	Assignments	Instructional Approach

Figure X-3

Student Progress Chart

Course: __________
Grade: __ **Period:** __
Semester: _____

3. Index of Available TAMS

The various curriculum projects and workshops conducted in Missouri have generated a large amount on very useful materials. Among the most popular have been the Technology Activity Modules (TAMS). These are available[1] in sets by buying/borrowing the ITE curriculum guides from IML or MVRC respectively.

TAM Title	Author	Source[2]	TAM#
Materials & Processing Technology			
Lamination: The Route to High Tech Materials	Marquardt, Don	W3	15
Model Home Construction	Dan Moppin	W3	
Recycling Materials: R&D Activities	Jim Nichols	W3	16
High Tech Glass	Rebecca Saylor	W3	7
Bio-Technology	Tom Trewyn	W3	19
Bridge Construction			
High Tech/Low Cost Wood Technology	James Kyd	W2	10
Simulated Material Structures Testing	Steve Murray	W2	13
Model House Construction	Dan Moppin	W3	4
Materials Properties & Testing	John Petsch	W2	14
Manufactured Car Activity	Robert Walker	W3	6
Glass Fabrication and Processing	Guide writing team	M&P	3
Fiberglass Fabrication	Guide writing team	M&P	4
Nondestructive Testing	Guide writing team	M&P	5
Bridge Construction	Guide writing team	M&P	6
Construction Projects	Guide writing team	M&P	7
Concrete Processing	Guide writing team	M&P	8
Jigs and Fixtures	Guide writing team	M&P	9
Automated Manufacturing	Guide writing team	M&P	10
Robotics	Guide writing team	M&P	11
Mass Production	Guide writing team	M&P	12
Energy & Power Technology			
Fuel Evaluation Cannon (Physics is useful!)	Bill Bratberg	W3	11
Exciting students with Small Gas Engines	John DeBey	W3	8
R&D via the Missouri 500	Dan Eckard	W3	13
Hovercraft Technology	Dean Frame	W3	9
Innovative applications for Pneumatic Technology	Eric Headley	W3	3

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[1] TAMs are available in sets from IML (purchase) and MVRC (loan). An additional index of over 200 available CITE modules can be obtained from: Center for Implementing Technology Education, Department of Industry & Technology, Ball State University, Muncie, IN 47306, 317: 285-5659.

[2] Code:

IT = Introduction to Technology/Industrial Technology
ET = Exploration of Technology/Industrial Technology
CT = Introduction to Communication Technology
E&P = Introduction to Energy and Power Technology
M&P = Introduction to Materials and Processing Technology

W1 = 1989 ITE Workshop Series
W2 = 1990 ITE Workshop Series
W3 = 1991 ITE Workshop Series

Energy & Power Technology, continued	Author	Source	TAM#
Flight Technology and Aerodynamics	Steve Murray	W3	1
Human Powered Tractor Pull	Tim Trogdon	W3	20
LEGO Energy & Power Activities	Alice Mohr	W2	8
Laser Applications	John McGee	W3	11
Hurricane Alley	James Wehar	W2	20
Energy and Power Odyssey - Applications for the Future	Steve Murray	E&P	1
Adventures With Systems Theory	Michael J. Dyrenfurth	E&P	2
Designing and Conducting Experiments	Yusuf Al-Hassan	E&P	3
Technology Assessment Process	Yusuf Al-Hassan	E&P	4
Energy Conversions	Rod Custer	E&P	5
Physics Revealed/Made Useful	Michael J. Dyrenfurth	E&P	6
Adventures in Flight	Steve Murray	E&P	7
Internal Combustion: Energy Converters	John Sapko	E&P	8
Fundamentals of Fluid Power	Yusuf Al-Hassan	E&P	9
Fundamentals of Mechanical Power Trans'n	Tim Trogdon	E&P	10
Electric Motor Control Revealed	David Roth	E&P	11
Instrumentation and Control Revealed	Lynn Diel	E&P	12
Energy Audits	Alice Mohr	E&P	13
Superconductivity: Speeding into the Future	Steve Murray	E&P	14
Making Lasers Work for Us	Craig Adams	E&P	15
Electrical Distribution Model	David Kempa	E&P	16
Applying Electric Motors	Lynn Diel	E&P	17
Using Electronic Instrumentation	Lynn Diel	E&P	18
Communication Technology			
Inexpensive, Portable Holography	Craig Adams	W3	10
ThermoScreen, -Printing	Michael Maxwell	W3	5
Computer Job Printing/Image Scanning	John McGee	W3	2
Newsletter Design	Tom Reynolds	W3	
Fibre Optic Communications	T. Rodrigue & D. Roth	W3	18
Communicating via Computer and FAX	Lynn Diel	W3	12
Laser Applications	John McGee	W2	11
Video Syncracies	Mike Allen	W2	1
Fiber Optics	Don Costello	W2	2
Graphic Arts Technology	Mark Doss	W2	6
Desktop Publishing	Tom Reynolds	W2	12
The Information Age	Tim Trodgen	W2	19
Time Travel-Communication Style	Ron Sorensen	CT	1
Using ASCII for Telecommunication	Dick Kahoe	CT	2
CAD	Kyle Palmer	CT	3
Desktop Publishing	Mark Rankin	CT	4
Pinhole Cameras	Ben Yates	CT	5
Processing Transparency Film (Slides)	Janet Bonsall	CT	6
On-Line Computer Communication	Adrian Bernagozzi	CT	7
Laser Applications	Craig Adams	CT	8
Fiber Optics	Don Costello	CT	9

Communication Technology	Author	Source	TAM#
Intercom Systems	Ed Carter	CT	10
Home Security Monitorying Systems	Lynn Ash	CT	11
FM Transmitters	Clark Homoly	CT	12
Building an AM Receiver	Jerry Richter	CT	13
Video Syncracies	Mike Allen	CT	14
Animation	Jim Kyd	CT	17
General Technology			
Problem Solving: Egg Rockets	John DeBey	W2	5
Problem Solving with Marbles and Rube Goldberg	Dan Eckard	W2	7
Egg Container (Problem-solving)	James Gers	W2	9
Word Processing With Appleworks	James Helmick	W2	23
Motivation/First Week Production Activity		M&P	1
Problem-Solving Through Graphic Design	Mark Koca	CT	16
Problem-solving		M&P	2
Careers			
Getting the Job/Scholarship You Want	Yusuf-Al-Hassan	E&P	19
Career Development		M&P	14
Forming and Managing a Company		M&P	13
Getting The Job/Scholarship You Want	Yusuf Al-Hassan	E&P	19
Job Hunting Skills	Dan Stephens	CT	15
Leadership			
Today's Leaders for Tomorrow	Yusuf Al-Hassan	E&P	20
Leadership Development		M&P	15
Leadership in Technology and Group Interaction	Frank Johnson	W3	14
17 ITE Organization	Ray J. Riley	W2	17

4. *Recommended ITE/TE Competencies and Articulation Links*

Articulation of ITE Competencies from Course to Course

The following pages document the competencies suggested for each of the five courses in ITE/TE's scope and sequence:

- Introduction to Technology/Industrial Technology
- Exploration of Technology/Industrial Technology
- Introduction to Communication Technology
- Introduction to Energy & Power Technology
- Introduction to Materials & Processing Technology

The charts in this section present the competencies in a layout that graphically shows the students' recommended progression. Also depicted is how each course builds upon previously developed competencies. Several key articulation principles were used in specifying the relationships among course competencies. These principles are shown in Figure X-4.

Figure X-4

Key Competency Articulation Principles

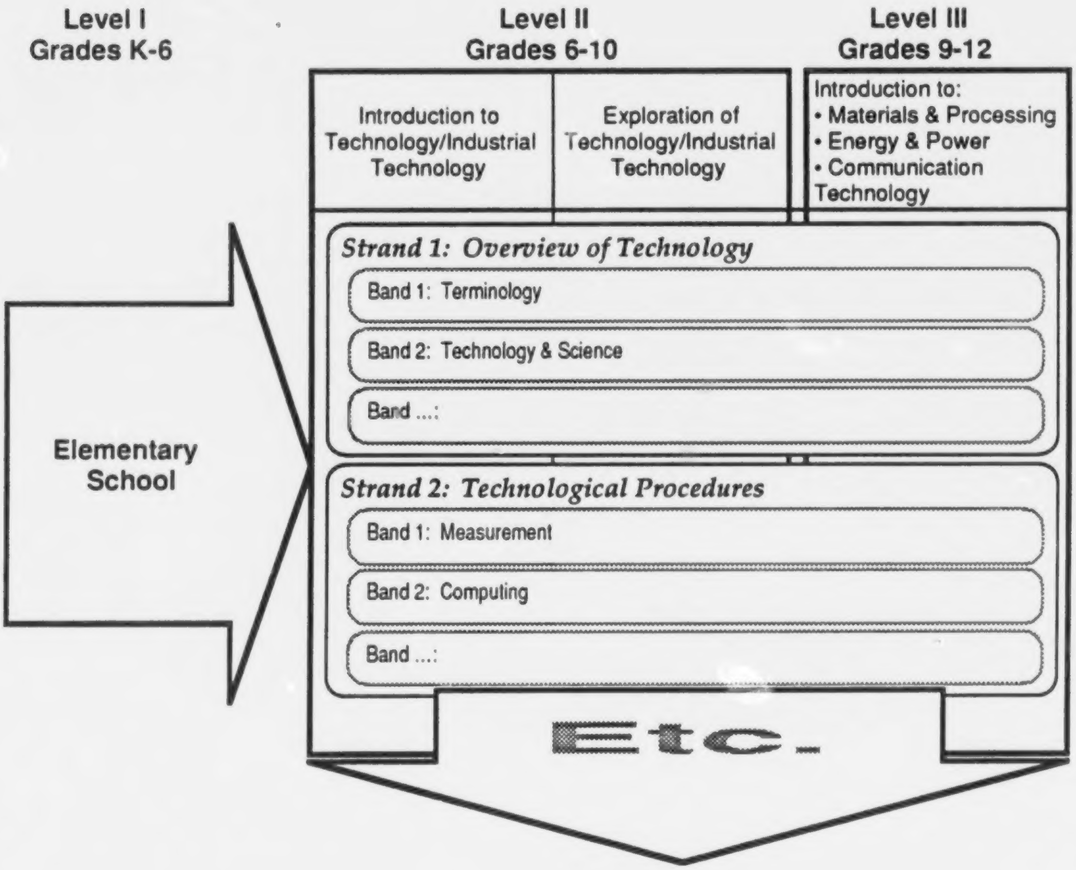
1. **Simple to complex arrangement.** Essentially, student movement through the courses should show evidence of progressive depth, complexity, integration, and difficulty by progression to ever higher levels of cognitive, affective, and sensori-motor performance.
2. **Curriculum is structured spirally to reinforce and raise competency levels.** This is basically the issue raised in #1. It is important that many competencies be addressed repeatedly, although at a higher level as students progress through the various levels of ITE.
3. **Specific-to-General/General-to-Specific flow.** Although this principle appears to be contradictory, it really is not. In some cases, it may be desirable to move toward an integration of specific skills (pulling it all together). Alternatively, there will be numerous cases where the Introduction and Exploration courses will be introducing students to general principles which will be pursued in more depth in the cluster specific courses. A balance of both approaches was sought.
4. **Competencies identify unchanging fundamentals.** The essence of this principle is to identify those fundamentals that are likely to have the longest "half life." Given the rapid rate of technological change, the attempt was to target those competencies which will be the most enduring and important for the future.
5. **Avoiding repetition.** Competencies are not repeated from course to course. This does not mean that competencies cannot be readdressed in the upper level courses. Indeed they should be, although at a higher level.
6. **Activity and action orientation** There is a critical need to maintain an activity orientation for ITE/TE. A balance between "thinking" and "doing" competencies was sought.
7. **Linking to core competencies.** Competencies were coded to indicate if they directly or indirectly reinforced Missouri's core competencies.
8. **Manageability.** The attempt was to keep the number of competencies at a manageable level and to arrange them so oversight is facilitated. Some careful attention to principle #7 was involved.
9. **Organized according to threads/conceptual frameworks.** The attempt is to maintain a "big picture" orientation, by using strands and bands, as students progress through the competencies.
10. **Uniform Level of Detail.** The competencies need to be specific enough to convey meaning and involve activity. At the same time they need to be general enough to allow for more specific development by individual teachers. There ought to be parity in level of detail of the various competencies.

The results of the articulation work are presented in the tables following page 10. These tables show Missouri's ITE/TE competencies in **three columns representing the progression** from Level II's Introduction to Technology/Industrial Technology and Exploration of Technology/Industrial Technology to each of the Level III system/cluster courses of Materials & Processing, Energy & Power and Communication technology. In a few cases, this progression continues into a fourth column which contains Level IV competencies. These represent, as per ITE/TE's scope and sequence, high order analysis, synthesis and application competencies.

Furthermore, the competencies are grouped into eight major **strands that represent the recommended major units of instruction** across all of the courses. Finally, the competencies in each strand are grouped by topic into **clearly related families called bands**. Figure X-5 depicts the relationships among levels, courses, strands and bands.

Figure X-5

Competency Articulation Chart Structure


Level I
Grades K-6
Level II
Grades 6-10
Level III
Grades 9-12
Introduction to Technology/Industrial Technology
Exploration of Technology/Industrial Technology
Introduction to:
• Materials & Processing
• Energy & Power
• Communication Technology
Elementary School
Strand 1: Overview of Technology
Band 1: Terminology
Band 2: Technology & Science
Band ...:
Strand 2: Technological Procedures
Band 1: Measurement
Band 2: Computing
Band ...:
Etc.

Articulation of ITE/TE Competencies to MO's Core Competencies (Basic Skills)

Additionally, each competency was examined for its potential to reinforce Missouri's core competencies. These basic skills are presented in Figure X-6 Because of the importance of capitalizing on ITE/TE's extensive motivating and reinforcing power, these articulation links are also documented in the competency tables following page 13.

A code, provided in **bold** letters and within [ ] at the end of each competency statement indicates which core competency is reinforced. Furthermore, the nature of that reinforcement is categorized in one of two classes. A code indicates (R = direct, I = indirect) whether the ITE/TE competency:

- Reinforces the Missouri DESE Core Competency **directly**. This means that students using typical learning experiences almost invariably perform activities that reinforce the state's core competency.

or

- Has great potential for **indirectly** reinforcing the Missouri DESE's core competency (with reasonable teacher intervention)

Write, produce and record a television segment.
[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]

Use of Competency Charts

ITE/TE instructors are encouraged to use the competency charts extensively. They might well be posted around the laboratory to give students a sense of where they are (and where they are going) in the course. The charts also provide instructors important suggestions for the sequencing of student activities. Finally the charts can also be used to help plan interdisciplinary activities with other teachers in the school—particularly by focusing on the core competencies as linkage targets.

Figure X-6

Missouri DESE Core Competencies[1] (Basic Skills)

English/Language Arts, Grades 7-10

Reading

E-RB	Determine the meaning of unknown words in context.
E-RC	Demonstrate an understanding of narrative and expository text by re-telling, answering or formulating questions and thinking critically
E-RD	Employ appropriate strategies for locating and using information
E-RE	Demonstrate the value of reading for personal development.

Writing

E-WF	Use the tools of means for writing.
E-WG	Use the steps of the writing process: pre-writing, composing, revising proofing/editing, sharing the product.

Listening/Speaking

E-OH	Listen attentively and critically.
E-OI	Use conventions of oral language.
E-OJ	Organize thoughts, ideas and materials for listening and speaking.
E-OK	Use and respond to verbal and nonverbal communication.

Mathematics, Grades 7-10

M-AA	Demonstrate an understanding of numbers.
M-AB	Apply the basic operations in computational situations.
M-AC	Estimate results and judge reasonableness of solutions.
M-AD	Apply the concept of measurement to the physical world.
M-AE	Recognize geometric relationships.
M-AF	Use statistical techniques and interpret statistical information.
M-AG	Apply problem-solving strategies.
M-AH	Solve problems in consumer situations.

Science, Grades 7-10

Life and Living Things

S-LA	Structure and Form: Students will understand that forms/units of matter, energy, and life can be identified by the structural characteristics of each. These can be classified according to similarities and differences.
S-LB	Structure and Function: Students will understand that characteristics of life systems explain their functions; properties of matter and energy explain their effects.
S-LC	Continuity Through Change: Students will understand that matter, energy, and life respond to change and yet continue.
S-LD	Interaction in a System: Students will understand that matter, energy, and/or life forms/units interact in systems.

Matter and Energy

S-YE	Structure and Form: Students will understand that forms/units of matter, energy and life can be identified by the structural characteristics of each. These can be classified according to similarities and differences.
S-YF	Structure and Function: Students will understand that characteristics of life systems explain their functions; properties of matter and energy explain their effects.
S-YG	Continuity Through Change: Students will understand that matter, energy, and life respond to change and yet continue.
S-YH	Interaction in a System: Students will understand that matter, energy, and/or life forms/units interact in systems.

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[1] Summarized from *Missouri Core Competencies and Key Skills*, 1988.

Figure X-6

Missouri DESE Core Competencies, continued

Earth and Universe

S-UI	Structure and Form: Students will understand that forms/units of matter, energy, and life can be identified by the structural characteristics of each. These can be classified according to similarities and differences.
S-UJ	Structure and Function: Students will understand that characteristics of life systems explain their functions; properties of matter and energy explain their effects.
S-UK	Continuity Through Change: Students will understand that matter, energy, and life respond to change and yet continue.
S-UL	Interaction in a System: Students will understand that matter, energy, and/or life forms/units interact in systems.

Social Studies, Grades 7-10

Geography

SS-GA	Locate and describe place; interpret maps.
SS-GB	Demonstrate an understanding of how people relate to their environment.
SS-GC	Demonstrate an understanding of patterns of human movement and how different places relate to each other.
SS-GD	Identify, describe, and compare regions.

History

SS-HE	Possess skills important for interpreting historical materials.
SS-HF	Demonstrate knowledge of significant historical events and developments, their relationships to each other and to the present

Government

SS-CG	Understand and apply basic principles of our political system.
SS-CH	Understand basic institutions and processes of law making, law enforcement and law interpretation.
SS-CI	Understand rights and responsibilities of citizens in democratic societies.
SS-CJ	Understand processes by which citizens may help resolve disputes and influence policy making.
SS-CK	Analyze real and hypothetical cases in relation to persistent issues of government in American society.
SS-CL	Apply analytic skills to political messages and discussions.

Economics

SS-DM	Analyze economic decisions situations with awareness of opportunity costs and trade-offs.
SS-DN	Understand factors of production, their interrelationships and how investment in them relates to productivity.
SS-D0	Understand economic relationships—the circular flow of money, goods and services among households and businesses in the U.S economy.
SS-DP	Understand relationships among supply, demand, price, and quantity of goods and services in market economies.
SS-DQ	Understand the role of government in the United States and other economic systems.
SS-DR	Understand principles related to money and trade.

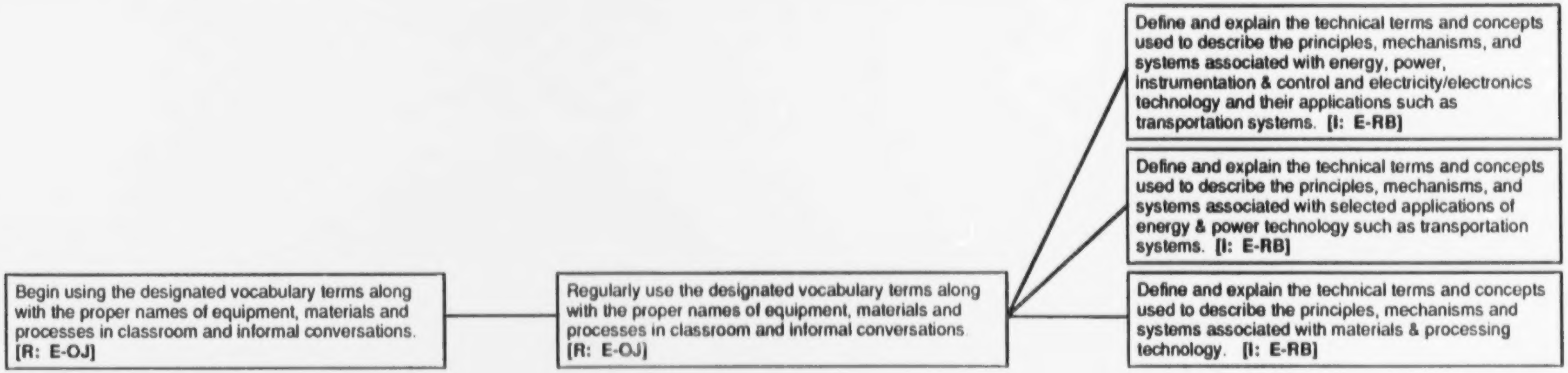
Other Social Studies Competencies

SS-XS	Understand cause-effect relationships related to the behavior of individuals and groups.
SS-XT	Understand institutions and processes for meeting basic human needs.
SS-XU	Understand that cultures are similar in having belief systems, institutions and social structures; yet the details of those belief systems, institutions and social structures vary.
SS-XV	Understand and use appropriate techniques for investigating social studies topics.

Strand #1: Overview of Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Terminology



Level 2 Introduction

Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-OJ]**

Level 2 Exploration

Regularly use the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-OJ]**

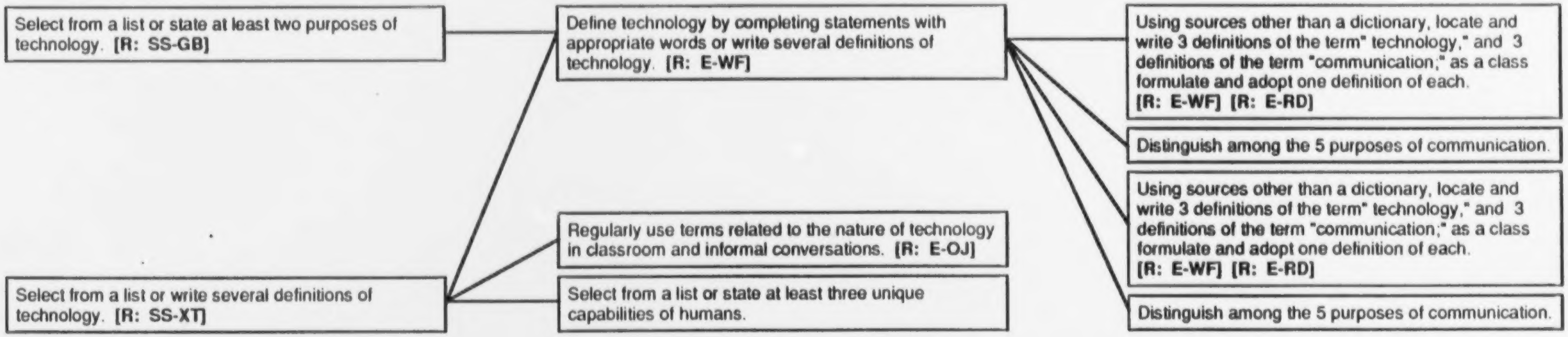
Level 3 Intermediate

Define and explain the technical terms and concepts used to describe the principles, mechanisms, and systems associated with energy, power, instrumentation & control and electricity/electronics technology and their applications such as transportation systems. **[I: E-RB]**

Define and explain the technical terms and concepts used to describe the principles, mechanisms, and systems associated with selected applications of energy & power technology such as transportation systems. **[I: E-RB]**

Define and explain the technical terms and concepts used to describe the principles, mechanisms and systems associated with materials & processing technology. **[I: E-RB]**

Technology & Science



Level 2 Introduction

Select from a list or state at least two purposes of technology. **[R: SS-GB]**

Select from a list or write several definitions of technology. **[R: SS-XT]**

Level 2 Exploration

Define technology by completing statements with appropriate words or write several definitions of technology. **[R: E-WF]**

Regularly use terms related to the nature of technology in classroom and informal conversations. **[R: E-OJ]**

Select from a list or state at least three unique capabilities of humans.

Level 3 Intermediate

Using sources other than a dictionary, locate and write 3 definitions of the term" technology," and 3 definitions of the term "communication;" as a class formulate and adopt one definition of each. **[R: E-WF] [R: E-RD]**

Distinguish among the 5 purposes of communication.

Using sources other than a dictionary, locate and write 3 definitions of the term" technology," and 3 definitions of the term "communication;" as a class formulate and adopt one definition of each. **[R: E-WF] [R: E-RD]**

Distinguish among the 5 purposes of communication.

Strand #1: Overview of Technology

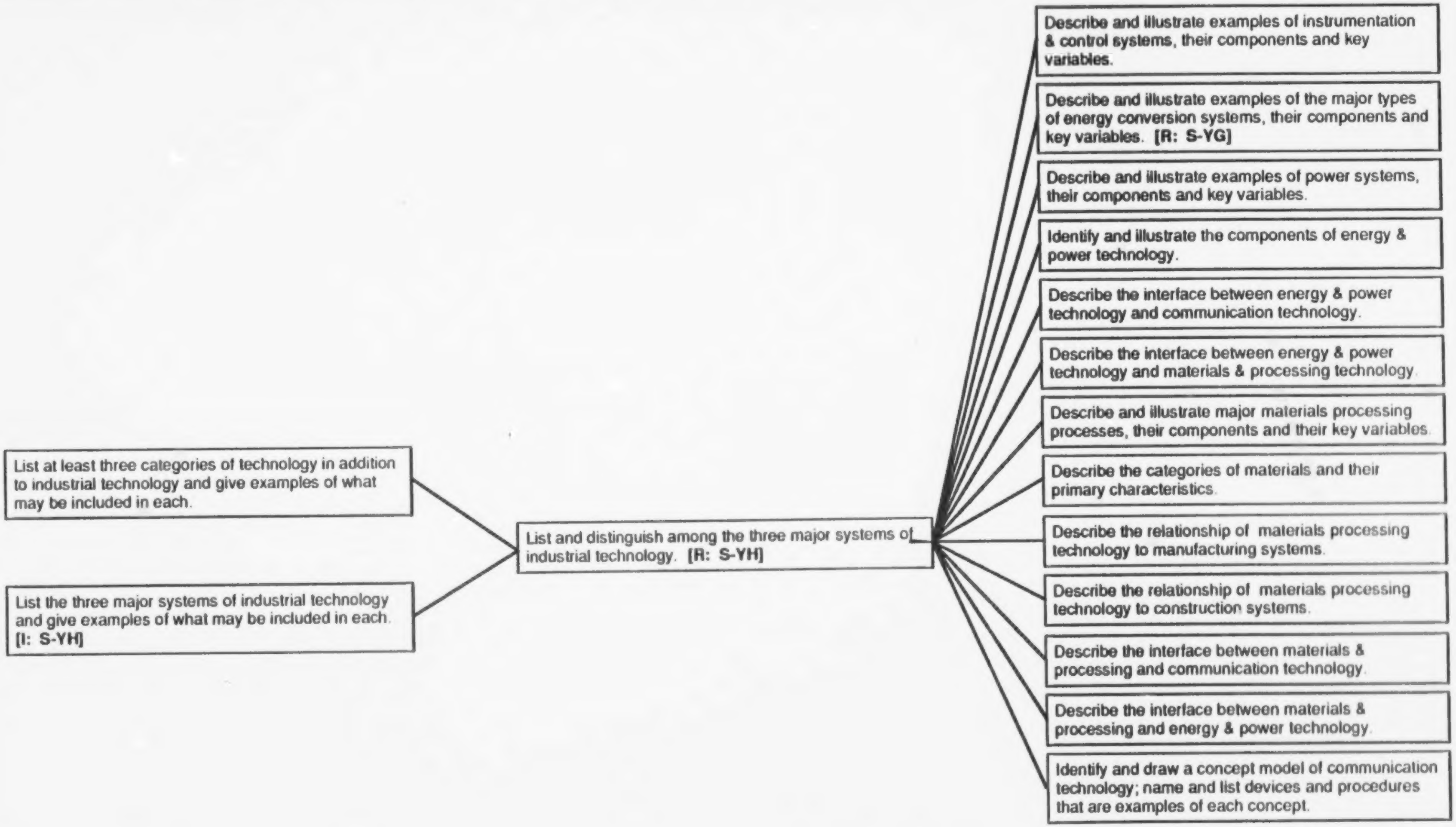
Technology & Science (continued)

Level 2 Introduction	Level 2 Exploration	Level 3 Intermediate
Select from a list or draw a diagram showing the components or resources of technology.	Match or state examples of each resource or component of technology.	
Select appropriate comparative statements or write a paragraph comparing science and technology. **[R: E-WF]**	Write a paragraph comparing science and technology. **[R: E-WF]**	
State or write a description of at least two applications each of science, mathematics, social studies and language arts to technology. **[R: E-WF]**	Write a paragraph describing a personal experience that shows the use of technology in a given situation/time frame and the application of science, mathematics, social studies, and language arts to this technology. **[R: E-WF]**	**Employ exponents to facilitate mathematical calculations. [R: M-AB]** **Perform calculations and conversion operations using basic mathematical functions. [R: M-AB]** **Use the physical principles of simple machines to explain the operation of power transmission systems. [R: S-YF] [R: M-AB]** **Apply the basic scientific foundations of chemistry, physics and mathematics to explain the operation of key energy & power technology processes. [R: S-YF] [R: M-AB]** **Explain the chemistry involved in key energy conversion processes such as combustion. [R: S-YF] [R: M-AB]** **Apply the basic scientific foundations of chemistry, physics and mathematics to explain the operation of key materials & processing technology processes. [R: S-YF] [R: M-AD]** **Explain selected chemical concepts involved in the processing of metals, plastics, ceramics and cellulose materials. [R: S-YF]** **Explain selected physics concepts involved in the processing of metals, plastics, ceramics and cellulose materials. [R: S-YF]** **Perform calculations and conversion operations pertinent to size, volume, area and density. [R: M-AB]** **Describe Cartesian coordinate systems and their application to computerized production processes. [R: M-AD] [R: M-AE]**

Strand #1: Overview of Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Technology & Science (continued)



List at least three categories of technology in addition to industrial technology and give examples of what may be included in each.

List the three major systems of industrial technology and give examples of what may be included in each. **[I: S-YH]**

List and distinguish among the three major systems of industrial technology. **[R: S-YH]**

Describe and illustrate examples of instrumentation & control systems, their components and key variables.

Describe and illustrate examples of the major types of energy conversion systems, their components and key variables. **[R: S-YG]**

Describe and illustrate examples of power systems, their components and key variables.

Identify and illustrate the components of energy & power technology.

Describe the interface between energy & power technology and communication technology.

Describe the interface between energy & power technology and materials & processing technology.

Describe and illustrate major materials processing processes, their components and their key variables.

Describe the categories of materials and their primary characteristics.

Describe the relationship of materials processing technology to manufacturing systems.

Describe the relationship of materials processing technology to construction systems.

Describe the interface between materials & processing and communication technology.

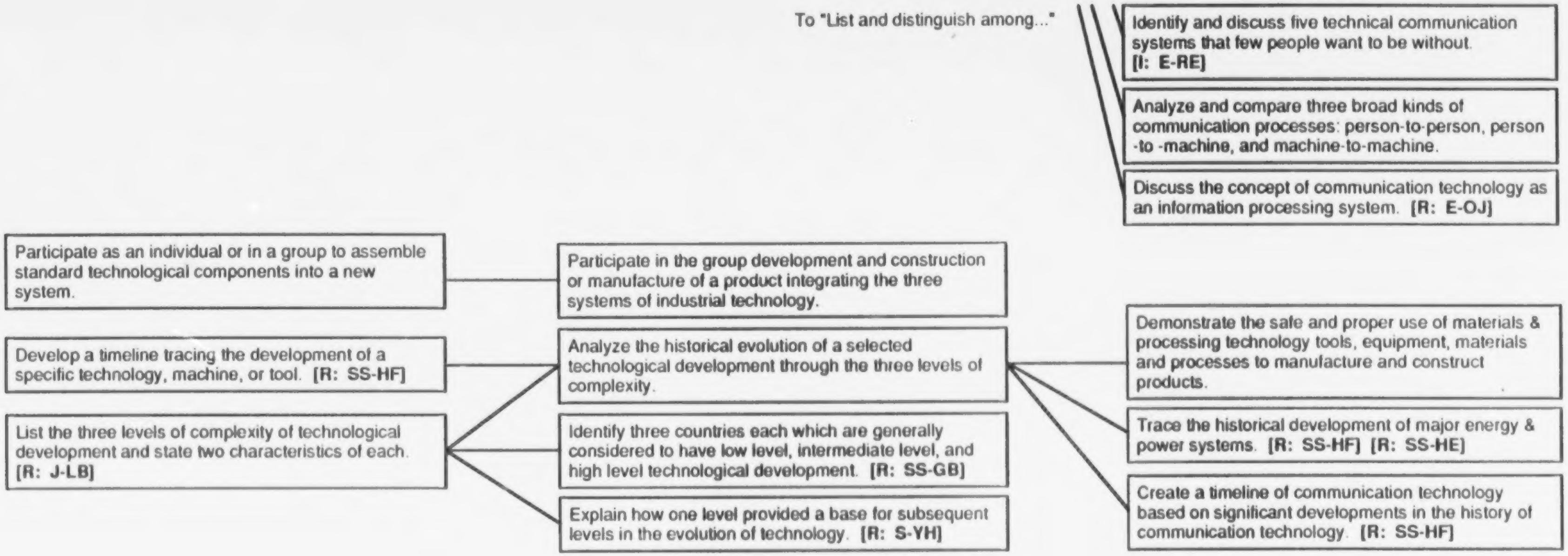
Describe the interface between materials & processing and energy & power technology.

Identify and draw a concept model of communication technology; name and list devices and procedures that are examples of each concept.

Strand #1: Overview of Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Technology & Science (continued)



To "List and distinguish among..."

Level 2 Introduction

Participate as an individual or in a group to assemble standard technological components into a new system.

Develop a timeline tracing the development of a specific technology, machine, or tool. [R: SS-HF]

List the three levels of complexity of technological development and state two characteristics of each. [R: J-LB]

Level 2 Exploration

Participate in the group development and construction or manufacture of a product integrating the three systems of industrial technology.

Analyze the historical evolution of a selected technological development through the three levels of complexity.

Identify three countries each which are generally considered to have low level, intermediate level, and high level technological development. [R: SS-GB]

Explain how one level provided a base for subsequent levels in the evolution of technology. [R: S-YH]

Level 3 Intermediate

Identify and discuss five technical communication systems that few people want to be without. [I: E-RE]

Analyze and compare three broad kinds of communication processes: person-to-person, person -to -machine, and machine-to-machine.

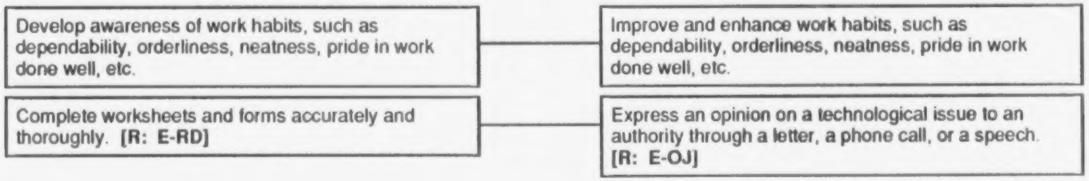
Discuss the concept of communication technology as an information processing system. [R: E-OJ]

Demonstrate the safe and proper use of materials & processing technology tools, equipment, materials and processes to manufacture and construct products.

Trace the historical development of major energy & power systems. [R: SS-HF] [R: SS-HE]

Create a timeline of communication technology based on significant developments in the history of communication technology. [R: SS-HF]

Employability Skills/Careers



Level 2 Introduction

Develop awareness of work habits, such as dependability, orderliness, neatness, pride in work done well, etc.

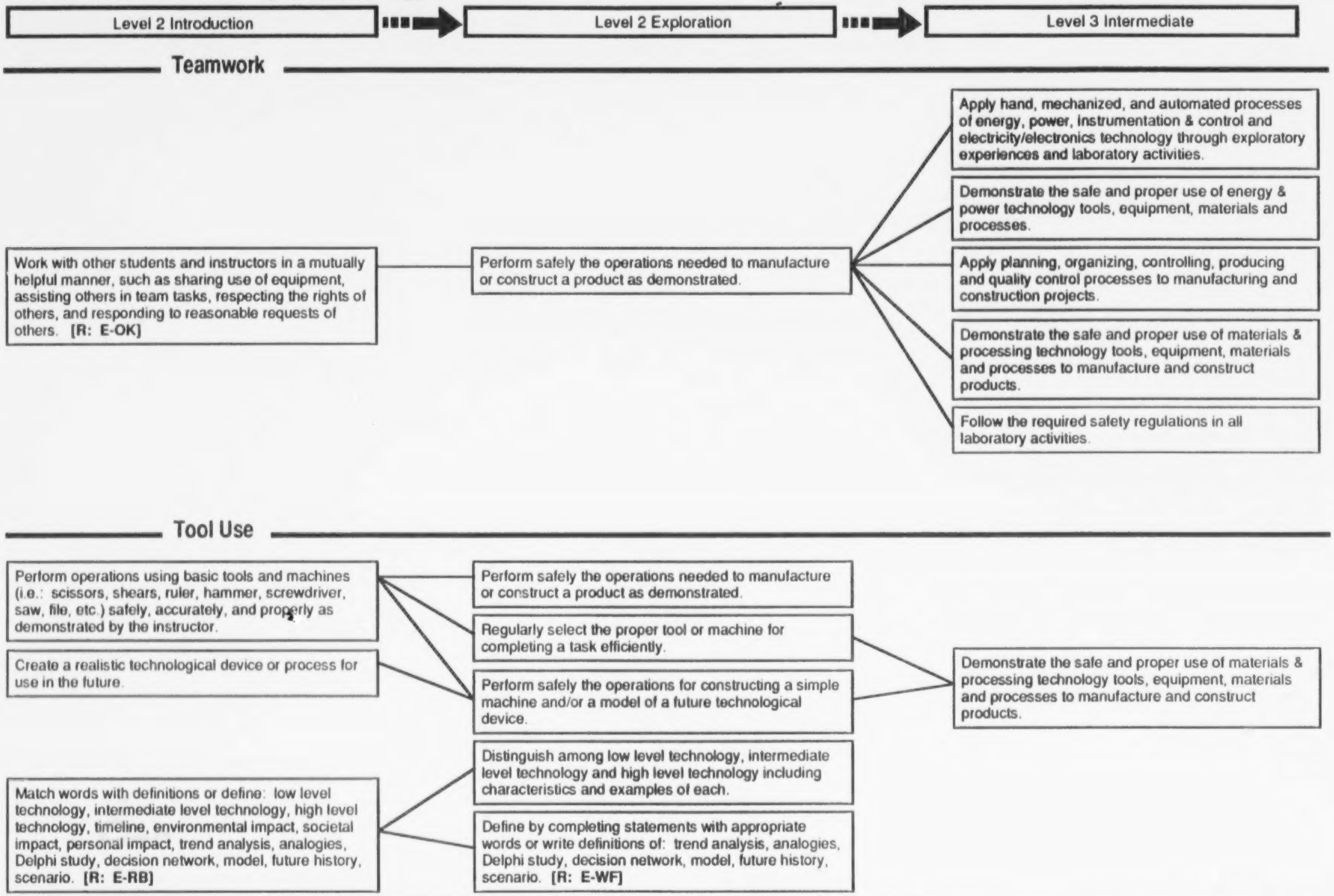
Complete worksheets and forms accurately and thoroughly. [R: E-RD]

Level 2 Exploration

Improve and enhance work habits, such as dependability, orderliness, neatness, pride in work done well, etc.

Express an opinion on a technological issue to an authority through a letter, a phone call, or a speech. [R: E-OJ]

Strand #1: Overview of Technology



Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Teamwork

Work with other students and instructors in a mutually helpful manner, such as sharing use of equipment, assisting others in team tasks, respecting the rights of others, and responding to reasonable requests of others. **[R: E-OK]**

Perform safely the operations needed to manufacture or construct a product as demonstrated.

Apply hand, mechanized, and automated processes of energy, power, instrumentation & control and electricity/electronics technology through exploratory experiences and laboratory activities.

Demonstrate the safe and proper use of energy & power technology tools, equipment, materials and processes.

Apply planning, organizing, controlling, producing and quality control processes to manufacturing and construction projects.

Demonstrate the safe and proper use of materials & processing technology tools, equipment, materials and processes to manufacture and construct products.

Follow the required safety regulations in all laboratory activities.

Tool Use

Perform operations using basic tools and machines (i.e.: scissors, shears, ruler, hammer, screwdriver, saw, file, etc.) safely, accurately, and properly as demonstrated by the instructor.

Create a realistic technological device or process for use in the future.

Match words with definitions or define: low level technology, intermediate level technology, high level technology, timeline, environmental impact, societal impact, personal impact, trend analysis, analogies, Delphi study, decision network, model, future history, scenario. **[R: E-RB]**

Perform safely the operations needed to manufacture or construct a product as demonstrated.

Regularly select the proper tool or machine for completing a task efficiently.

Perform safely the operations for constructing a simple machine and/or a model of a future technological device.

Distinguish among low level technology, intermediate level technology and high level technology including characteristics and examples of each.

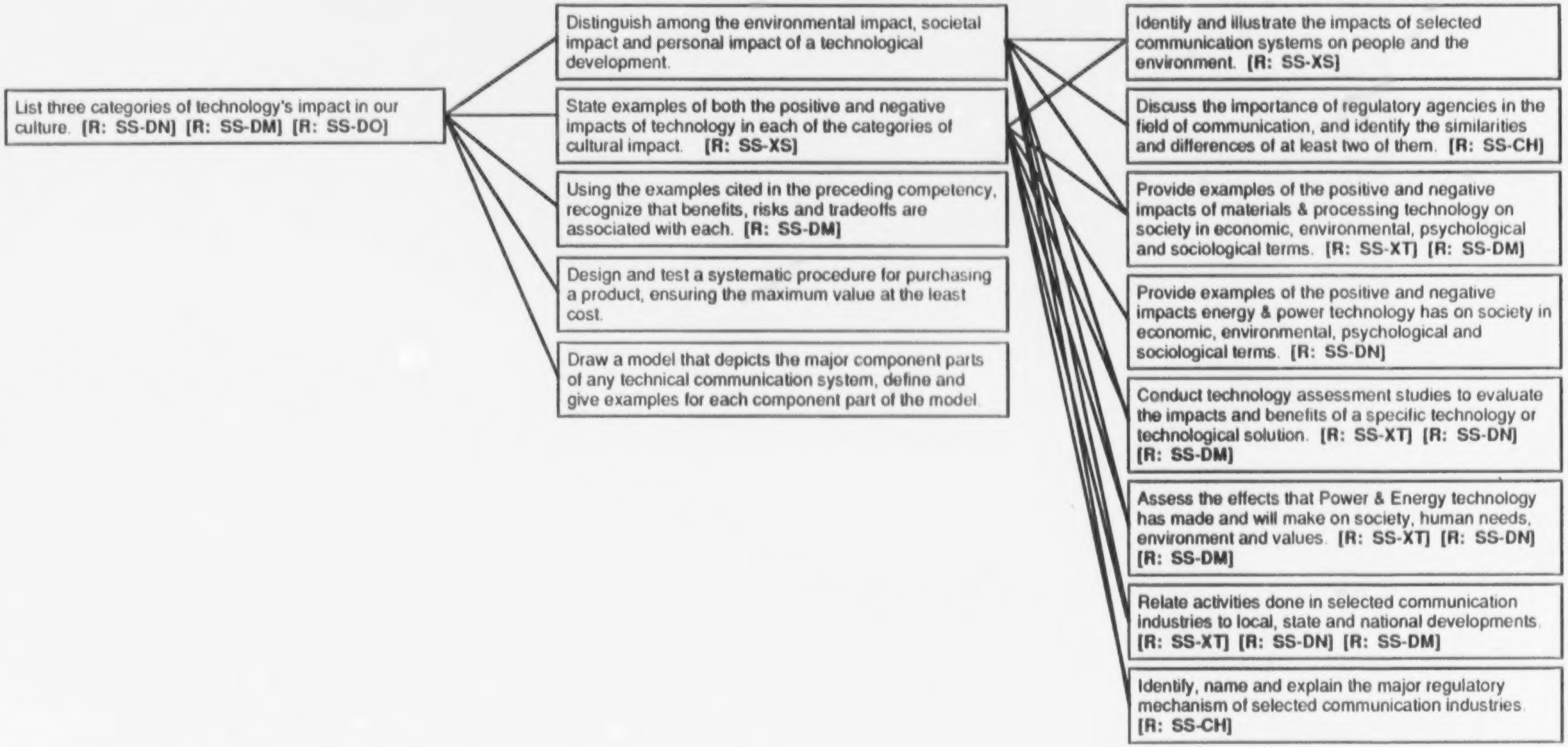
Define by completing statements with appropriate words or write definitions of: trend analysis, analogies, Delphi study, decision network, model, future history, scenario. **[R: E-WF]**

Demonstrate the safe and proper use of materials & processing technology tools, equipment, materials and processes to manufacture and construct products.

Strand #1: Overview of Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Technology Assessment/Impacts/Consumer Effectiveness



Level 2 Introduction

List three categories of technology's impact in our culture. **[R: SS-DN] [R: SS-DM] [R: SS-DO]**

Level 2 Exploration

Distinguish among the environmental impact, societal impact and personal impact of a technological development.

State examples of both the positive and negative impacts of technology in each of the categories of cultural impact. **[R: SS-XS]**

Using the examples cited in the preceding competency, recognize that benefits, risks and tradeoffs are associated with each. **[R: SS-DM]**

Design and test a systematic procedure for purchasing a product, ensuring the maximum value at the least cost.

Draw a model that depicts the major component parts of any technical communication system, define and give examples for each component part of the model.

Level 3 Intermediate

Identify and illustrate the impacts of selected communication systems on people and the environment. **[R: SS-XS]**

Discuss the importance of regulatory agencies in the field of communication, and identify the similarities and differences of at least two of them. **[R: SS-CH]**

Provide examples of the positive and negative impacts of materials & processing technology on society in economic, environmental, psychological and sociological terms. **[R: SS-XT] [R: SS-DM]**

Provide examples of the positive and negative impacts energy & power technology has on society in economic, environmental, psychological and sociological terms. **[R: SS-DN]**

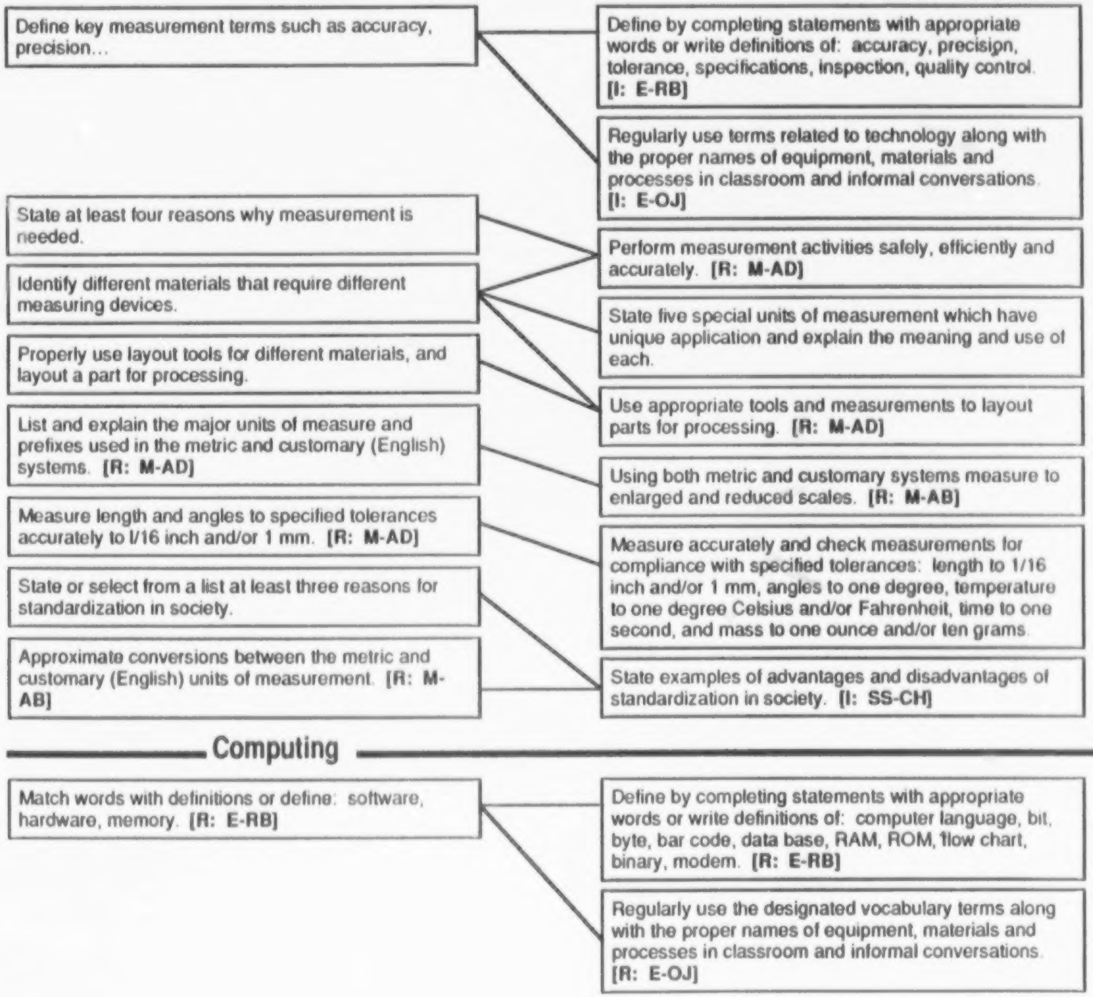
Conduct technology assessment studies to evaluate the impacts and benefits of a specific technology or technological solution. **[R: SS-XT] [R: SS-DN] [R: SS-DM]**

Assess the effects that Power & Energy technology has made and will make on society, human needs, environment and values. **[R: SS-XT] [R: SS-DN] [R: SS-DM]**

Relate activities done in selected communication industries to local, state and national developments. **[R: SS-XT] [R: SS-DN] [R: SS-DM]**

Identify, name and explain the major regulatory mechanism of selected communication industries. **[R: SS-CH]**

Strand #2: Technological Procedures



Measurement

Level 2 Introduction	Level 2 Exploration	Level 3 Intermediate
Define key measurement terms such as accuracy, precision...	Define by completing statements with appropriate words or write definitions of: accuracy, precision, tolerance, specifications, inspection, quality control. **[I: E-RB]**	
	Regularly use terms related to technology along with the proper names of equipment, materials and processes in classroom and informal conversations. **[I: E-OJ]**	
State at least four reasons why measurement is needed.	Perform measurement activities safely, efficiently and accurately. **[R: M-AD]**	
Identify different materials that require different measuring devices.	State five special units of measurement which have unique application and explain the meaning and use of each.	
Properly use layout tools for different materials, and layout a part for processing.	Use appropriate tools and measurements to layout parts for processing. **[R: M-AD]**	
List and explain the major units of measure and prefixes used in the metric and customary (English) systems. **[R: M-AD]**	Using both metric and customary systems measure to enlarged and reduced scales. **[R: M-AB]**	
Measure length and angles to specified tolerances accurately to l/16 inch and/or 1 mm. **[R: M-AD]**	Measure accurately and check measurements for compliance with specified tolerances: length to 1/16 inch and/or 1 mm, angles to one degree, temperature to one degree Celsius and/or Fahrenheit, time to one second, and mass to one ounce and/or ten grams.	
State or select from a list at least three reasons for standardization in society.		
Approximate conversions between the metric and customary (English) units of measurement. **[R: M-AB]**	State examples of advantages and disadvantages of standardization in society. **[I: SS-CH]**	

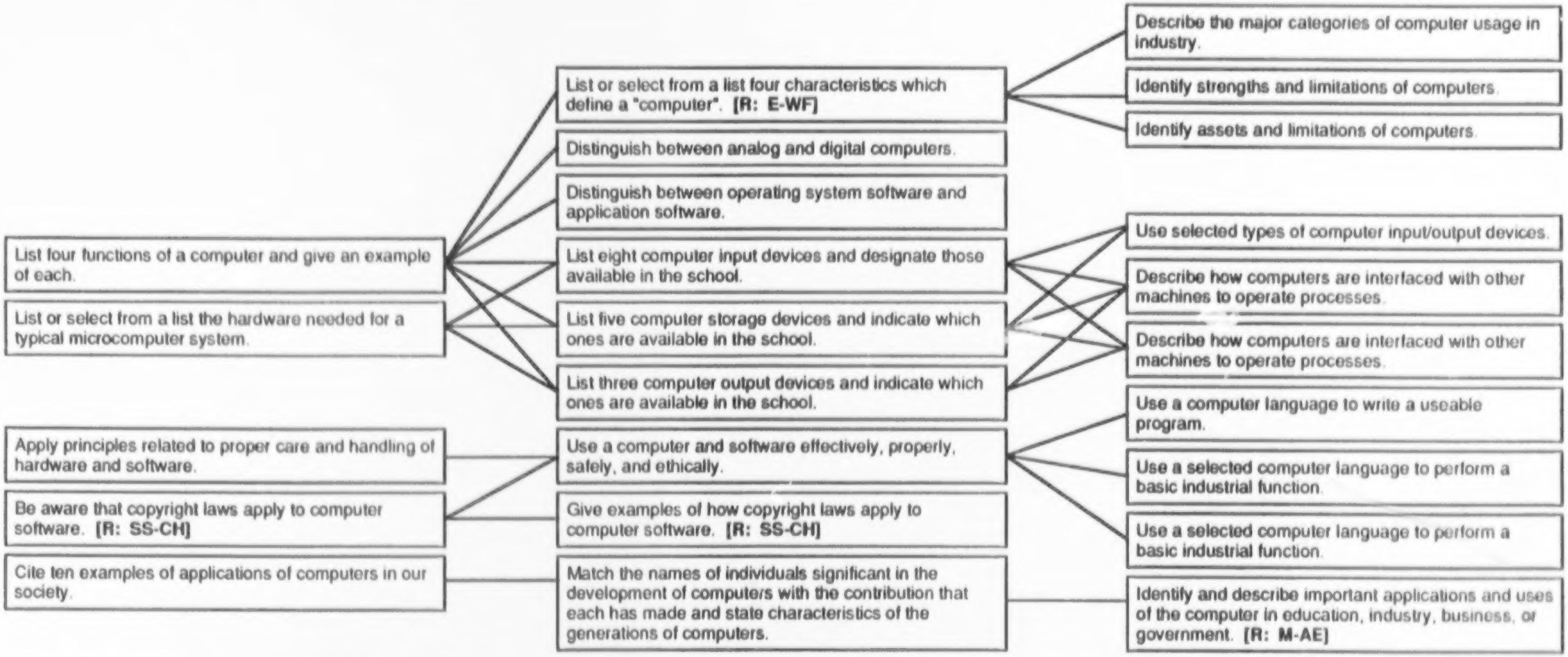
Computing

Level 2 Introduction	Level 2 Exploration	Level 3 Intermediate
Match words with definitions or define: software, hardware, memory. **[R: E-RB]**	Define by completing statements with appropriate words or write definitions of: computer language, bit, byte, bar code, data base, RAM, ROM, flow chart, binary, modem. **[R: E-RB]**	
	Regularly use the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-OJ]**	

Strand #2: Technological Procedures

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Computing (continued)



Level 2 Introduction

- List four functions of a computer and give an example of each.
- List or select from a list the hardware needed for a typical microcomputer system.
- Apply principles related to proper care and handling of hardware and software.
- Be aware that copyright laws apply to computer software. **[R: SS-CH]**
- Cite ten examples of applications of computers in our society.

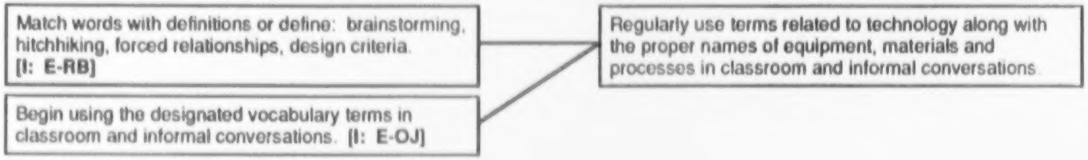
Level 2 Exploration

- List or select from a list four characteristics which define a "computer". **[R: E-WF]**
- Distinguish between analog and digital computers.
- Distinguish between operating system software and application software.
- List eight computer input devices and designate those available in the school.
- List five computer storage devices and indicate which ones are available in the school.
- List three computer output devices and indicate which ones are available in the school.
- Use a computer and software effectively, properly, safely, and ethically.
- Give examples of how copyright laws apply to computer software. **[R: SS-CH]**
- Match the names of individuals significant in the development of computers with the contribution that each has made and state characteristics of the generations of computers.

Level 3 Intermediate

- Describe the major categories of computer usage in industry.
- Identify strengths and limitations of computers.
- Identify assets and limitations of computers.
- Use selected types of computer input/output devices.
- Describe how computers are interfaced with other machines to operate processes.
- Describe how computers are interfaced with other machines to operate processes.
- Use a computer language to write a useable program.
- Use a selected computer language to perform a basic industrial function.
- Use a selected computer language to perform a basic industrial function.
- Identify and describe important applications and uses of the computer in education, industry, business, or government. **[R: M-AE]**

Problem-solving



Level 2 Introduction

- Match words with definitions or define: brainstorming, hitchhiking, forced relationships, design criteria. **[I: E-RB]**
- Begin using the designated vocabulary terms in classroom and informal conversations. **[I: E-OJ]**

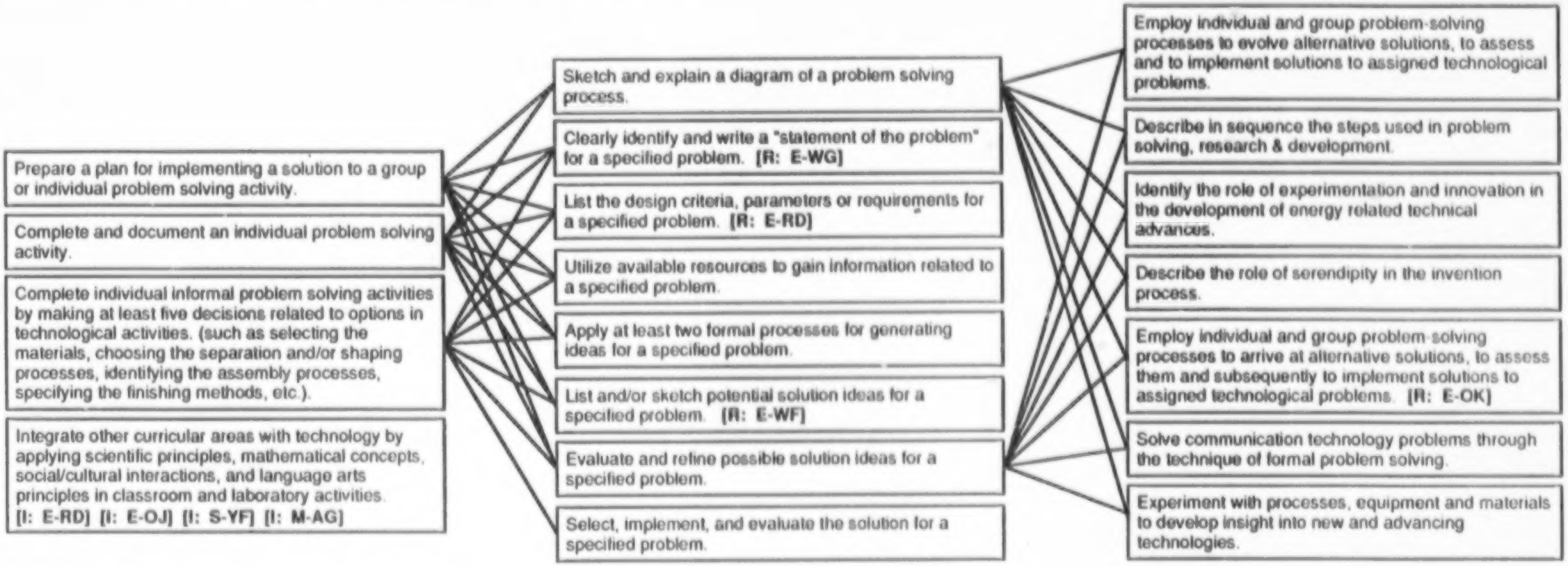
Level 2 Exploration

- Regularly use terms related to technology along with the proper names of equipment, materials and processes in classroom and informal conversations.

Strand #2: Technological Procedures

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Problem-solving (continued)



Level 2 Introduction

- Prepare a plan for implementing a solution to a group or individual problem solving activity.
- Complete and document an individual problem solving activity.
- Complete individual informal problem solving activities by making at least five decisions related to options in technological activities. (such as selecting the materials, choosing the separation and/or shaping processes, identifying the assembly processes, specifying the finishing methods, etc.).
- Integrate other curricular areas with technology by applying scientific principles, mathematical concepts, social/cultural interactions, and language arts principles in classroom and laboratory activities. **[I: E-RD] [I: E-OJ] [I: S-YF] [I: M-AG]**

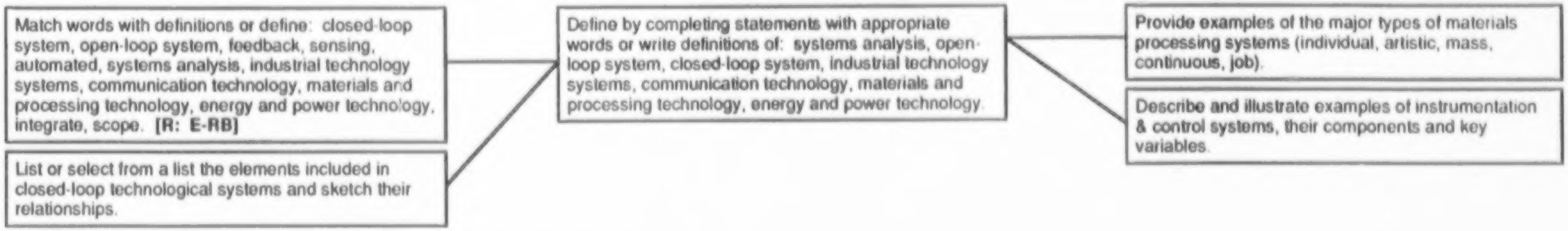
Level 2 Exploration

- Sketch and explain a diagram of a problem solving process.
- Clearly identify and write a "statement of the problem" for a specified problem. **[R: E-WG]**
- List the design criteria, parameters or requirements for a specified problem. **[R: E-RD]**
- Utilize available resources to gain information related to a specified problem.
- Apply at least two formal processes for generating ideas for a specified problem.
- List and/or sketch potential solution ideas for a specified problem. **[R: E-WF]**
- Evaluate and refine possible solution ideas for a specified problem.
- Select, implement, and evaluate the solution for a specified problem.

Level 3 Intermediate

- Employ individual and group problem-solving processes to evolve alternative solutions, to assess and to implement solutions to assigned technological problems.
- Describe in sequence the steps used in problem solving, research & development.
- Identify the role of experimentation and innovation in the development of energy related technical advances.
- Describe the role of serendipity in the invention process.
- Employ individual and group problem-solving processes to arrive at alternative solutions, to assess them and subsequently to implement solutions to assigned technological problems. **[R: E-OK]**
- Solve communication technology problems through the technique of formal problem solving.
- Experiment with processes, equipment and materials to develop insight into new and advancing technologies.

Systems Theory



Level 2 Introduction

- Match words with definitions or define: closed-loop system, open-loop system, feedback, sensing, automated, systems analysis, industrial technology systems, communication technology, materials and processing technology, energy and power technology, integrate, scope. **[R: E-RB]**
- List or select from a list the elements included in closed-loop technological systems and sketch their relationships.

Level 2 Exploration

- Define by completing statements with appropriate words or write definitions of: systems analysis, open-loop system, closed-loop system, industrial technology systems, communication technology, materials and processing technology, energy and power technology.

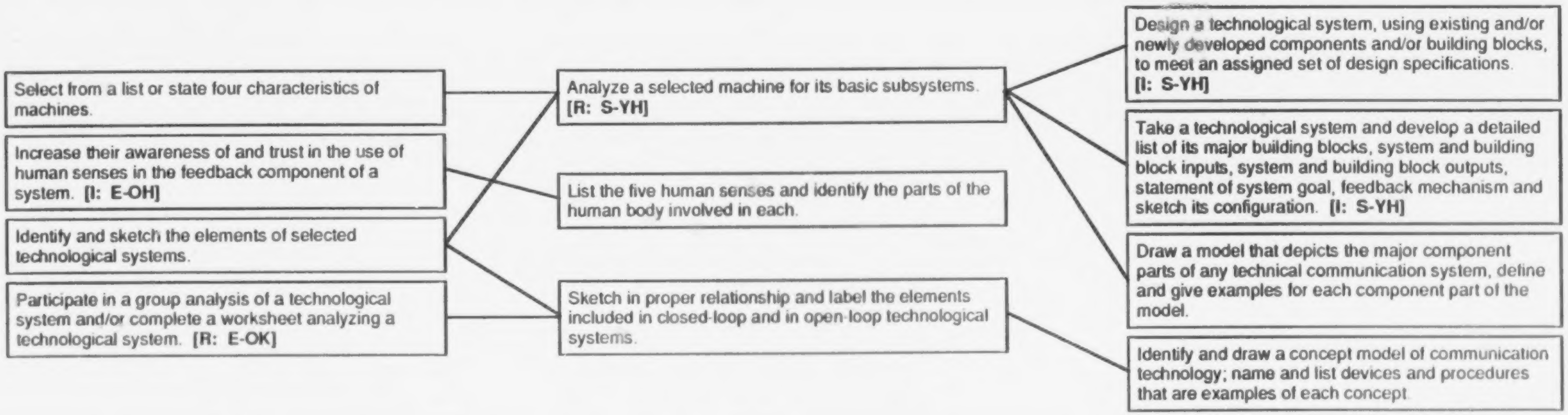
Level 3 Intermediate

- Provide examples of the major types of materials processing systems (individual, artistic, mass, continuous, job).
- Describe and illustrate examples of instrumentation & control systems, their components and key variables.

Strand #2: Technological Procedures

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Systems Theory (continued)



Level 2 Introduction:

- Select from a list or state four characteristics of machines.
- Increase their awareness of and trust in the use of human senses in the feedback component of a system. **[I: E-OH]**
- Identify and sketch the elements of selected technological systems.
- Participate in a group analysis of a technological system and/or complete a worksheet analyzing a technological system. **[R: E-OK]**

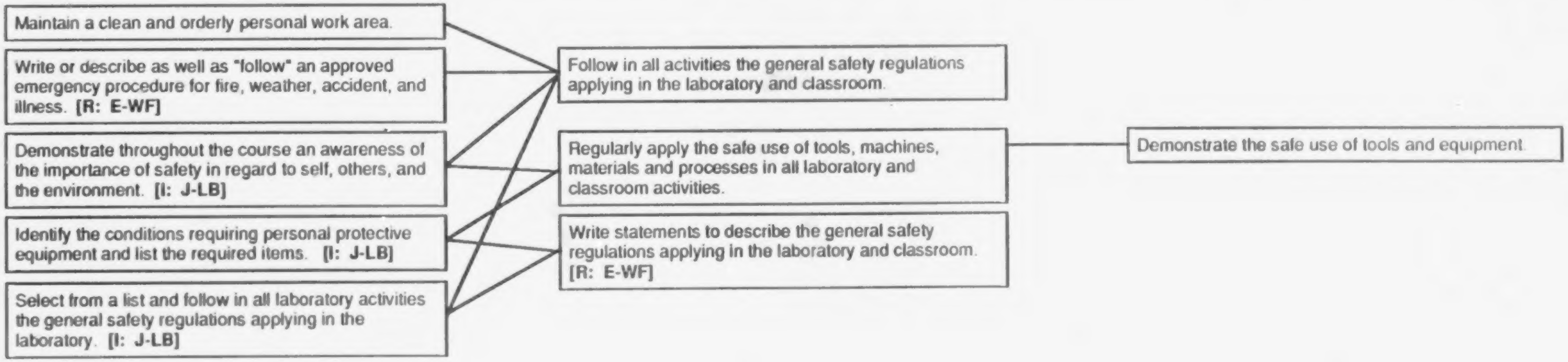
Level 2 Exploration:

- Analyze a selected machine for its basic subsystems. **[R: S-YH]**
- List the five human senses and identify the parts of the human body involved in each.
- Sketch in proper relationship and label the elements included in closed-loop and in open-loop technological systems.

Level 3 Intermediate:

- Design a technological system, using existing and/or newly developed components and/or building blocks, to meet an assigned set of design specifications. **[I: S-YH]**
- Take a technological system and develop a detailed list of its major building blocks, system and building block inputs, system and building block outputs, statement of system goal, feedback mechanism and sketch its configuration. **[I: S-YH]**
- Draw a model that depicts the major component parts of any technical communication system, define and give examples for each component part of the model.
- Identify and draw a concept model of communication technology; name and list devices and procedures that are examples of each concept.

Safety



Level 2 Introduction:

- Maintain a clean and orderly personal work area.
- Write or describe as well as "follow" an approved emergency procedure for fire, weather, accident, and illness. **[R: E-WF]**
- Demonstrate throughout the course an awareness of the importance of safety in regard to self, others, and the environment. **[I: J-LB]**
- Identify the conditions requiring personal protective equipment and list the required items. **[I: J-LB]**
- Select from a list and follow in all laboratory activities the general safety regulations applying in the laboratory. **[I: J-LB]**

Level 2 Exploration:

- Follow in all activities the general safety regulations applying in the laboratory and classroom.
- Regularly apply the safe use of tools, machines, materials and processes in all laboratory and classroom activities.
- Write statements to describe the general safety regulations applying in the laboratory and classroom. **[R: E-WF]**

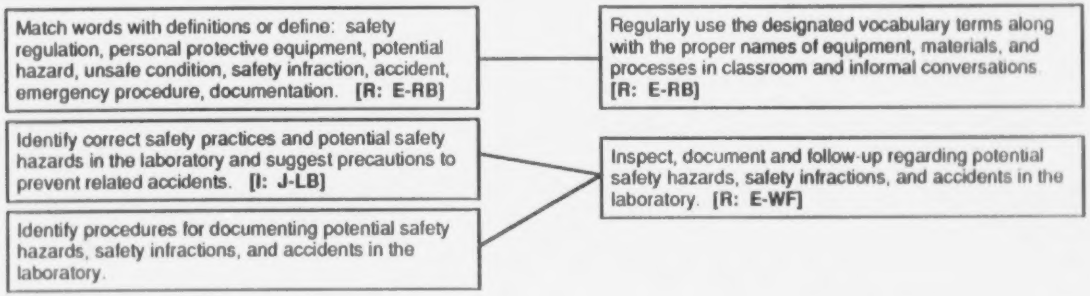
Level 3 Intermediate:

- Demonstrate the safe use of tools and equipment.

Strand #2: Technological Procedures

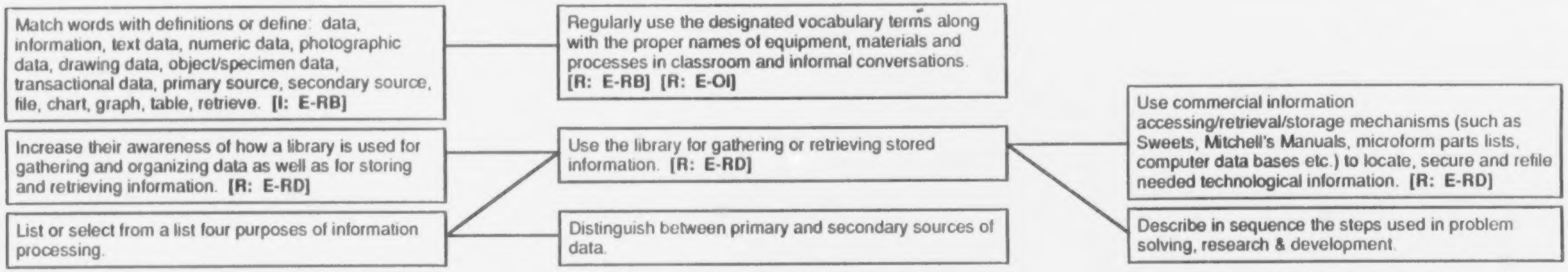
Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Safety (continued)



Level 2 Introduction	Level 2 Exploration	Level 3 Intermediate
Match words with definitions or define: safety regulation, personal protective equipment, potential hazard, unsafe condition, safety infraction, accident, emergency procedure, documentation. **[R: E-RB]**	Regularly use the designated vocabulary terms along with the proper names of equipment, materials, and processes in classroom and informal conversations. **[R: E-RB]**	
Identify correct safety practices and potential safety hazards in the laboratory and suggest precautions to prevent related accidents. **[I: J-LB]**	Inspect, document and follow-up regarding potential safety hazards, safety infractions, and accidents in the laboratory. **[R: E-WF]**	
Identify procedures for documenting potential safety hazards, safety infractions, and accidents in the laboratory.		

Information Utilization/Acquisition

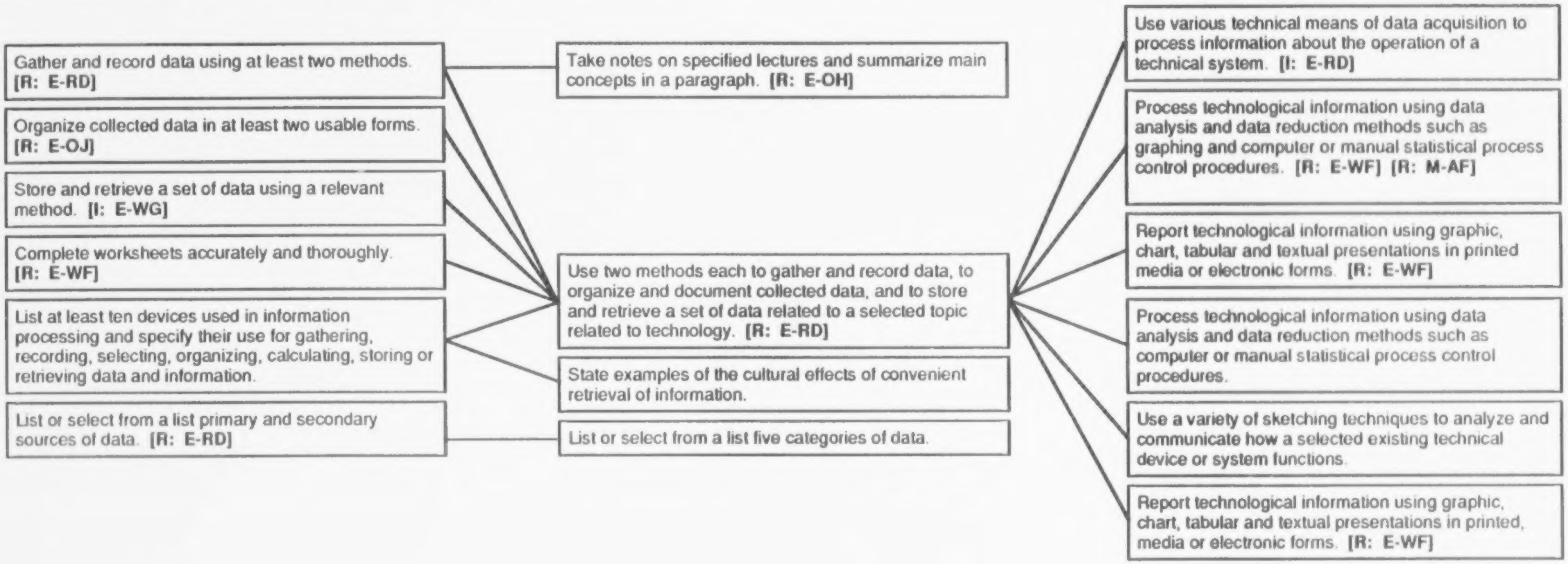


Level 2 Introduction	Level 2 Exploration	Level 3 Intermediate
Match words with definitions or define: data, information, text data, numeric data, photographic data, drawing data, object/specimen data, transactional data, primary source, secondary source, file, chart, graph, table, retrieve. **[I: E-RB]**	Regularly use the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-RB] [R: E-OI]**	
Increase their awareness of how a library is used for gathering and organizing data as well as for storing and retrieving information. **[R: E-RD]**	Use the library for gathering or retrieving stored information. **[R: E-RD]**	Use commercial information accessing/retrieval/storage mechanisms (such as Sweets, Mitchell's Manuals, microform parts lists, computer data bases etc.) to locate, secure and refile needed technological information. **[R: E-RD]**
List or select from a list four purposes of information processing.	Distinguish between primary and secondary sources of data.	Describe in sequence the steps used in problem solving, research & development.

Strand #2: Technological Procedures

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Information Utilization/Acquisition (continued)



Level 2 Introduction

- Gather and record data using at least two methods. **[R: E-RD]**
- Organize collected data in at least two usable forms. **[R: E-OJ]**
- Store and retrieve a set of data using a relevant method. **[I: E-WG]**
- Complete worksheets accurately and thoroughly. **[R: E-WF]**
- List at least ten devices used in information processing and specify their use for gathering, recording, selecting, organizing, calculating, storing or retrieving data and information.
- List or select from a list primary and secondary sources of data. **[R: E-RD]**

Level 2 Exploration

- Take notes on specified lectures and summarize main concepts in a paragraph. **[R: E-OH]**
- Use two methods each to gather and record data, to organize and document collected data, and to store and retrieve a set of data related to a selected topic related to technology. **[R: E-RD]**
- State examples of the cultural effects of convenient retrieval of information.
- List or select from a list five categories of data.

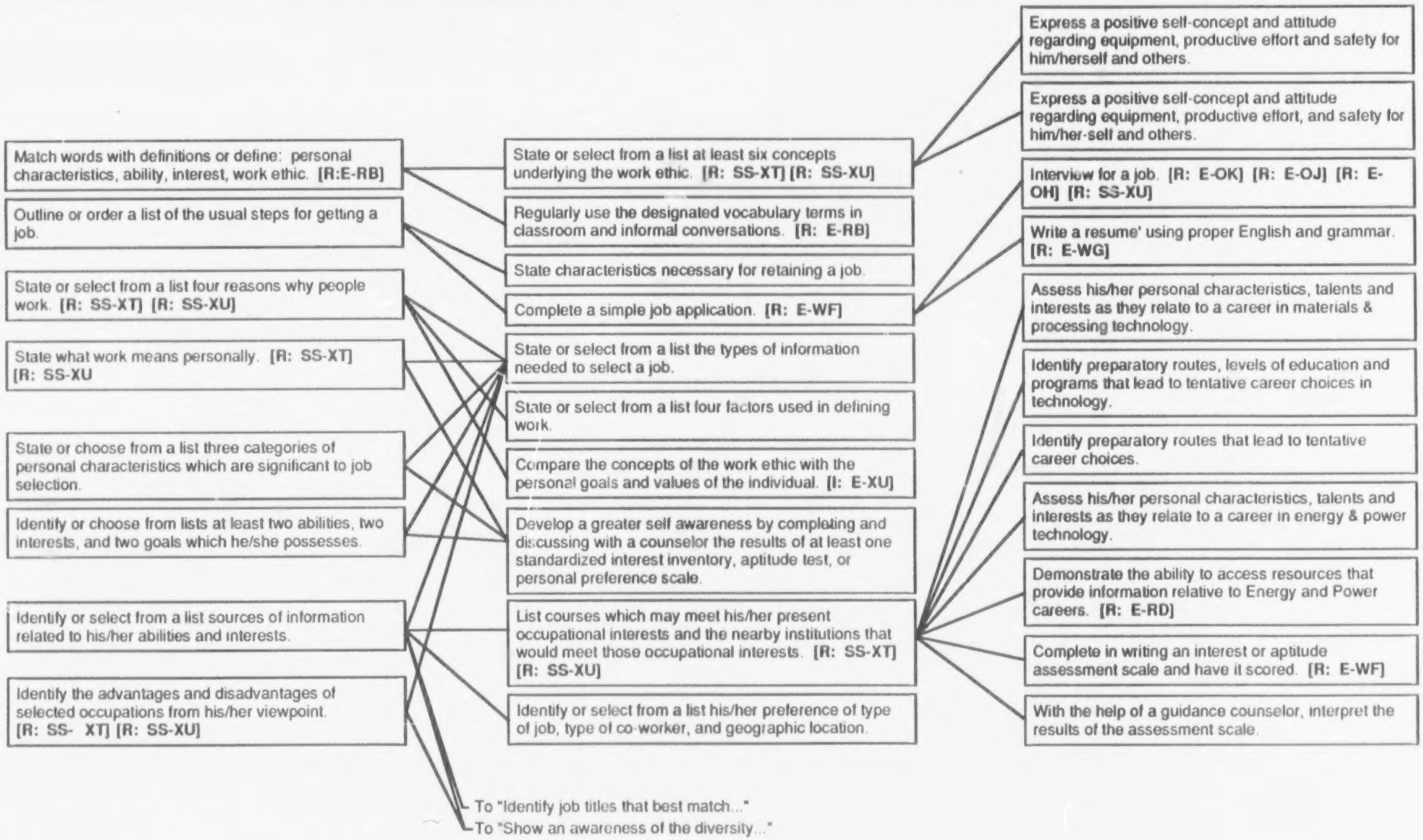
Level 3 Intermediate

- Use various technical means of data acquisition to process information about the operation of a technical system. **[I: E-RD]**
- Process technological information using data analysis and data reduction methods such as graphing and computer or manual statistical process control procedures. **[R: E-WF] [R: M-AF]**
- Report technological information using graphic, chart, tabular and textual presentations in printed media or electronic forms. **[R: E-WF]**
- Process technological information using data analysis and data reduction methods such as computer or manual statistical process control procedures.
- Use a variety of sketching techniques to analyze and communicate how a selected existing technical device or system functions.
- Report technological information using graphic, chart, tabular and textual presentations in printed, media or electronic forms. **[R: E-WF]**

Strand #3: Careers

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Careers



Match words with definitions or define: personal characteristics, ability, interest, work ethic. **[R:E-RB]**

Outline or order a list of the usual steps for getting a job.

State or select from a list four reasons why people work. **[R: SS-XT] [R: SS-XU]**

State what work means personally. **[R: SS-XT] [R: SS-XU**

State or choose from a list three categories of personal characteristics which are significant to job selection.

Identify or choose from lists at least two abilities, two interests, and two goals which he/she possesses.

Identify or select from a list sources of information related to his/her abilities and interests.

Identify the advantages and disadvantages of selected occupations from his/her viewpoint. **[R: SS- XT] [R: SS-XU]**

State or select from a list at least six concepts underlying the work ethic. **[R: SS-XT] [R: SS-XU]**

Regularly use the designated vocabulary terms in classroom and informal conversations. **[R: E-RB]**

State characteristics necessary for retaining a job.

Complete a simple job application. **[R: E-WF]**

State or select from a list the types of information needed to select a job.

State or select from a list four factors used in defining work.

Compare the concepts of the work ethic with the personal goals and values of the individual. **[I: E-XU]**

Develop a greater self awareness by completing and discussing with a counselor the results of at least one standardized interest inventory, aptitude test, or personal preference scale.

List courses which may meet his/her present occupational interests and the nearby institutions that would meet those occupational interests. **[R: SS-XT] [R: SS-XU]**

Identify or select from a list his/her preference of type of job, type of co-worker, and geographic location.

To "Identify job titles that best match..."

To "Show an awareness of the diversity..."

Express a positive self-concept and attitude regarding equipment, productive effort and safety for him/herself and others.

Express a positive self-concept and attitude regarding equipment, productive effort, and safety for him/her-self and others.

Interview for a job. **[R: E-OK] [R: E-OJ] [R: E-OH] [R: SS-XU]**

Write a resume' using proper English and grammar. **[R: E-WG]**

Assess his/her personal characteristics, talents and interests as they relate to a career in materials & processing technology.

Identify preparatory routes, levels of education and programs that lead to tentative career choices in technology.

Identify preparatory routes that lead to tentative career choices.

Assess his/her personal characteristics, talents and interests as they relate to a career in energy & power technology.

Demonstrate the ability to access resources that provide information relative to Energy and Power careers. **[R: E-RD]**

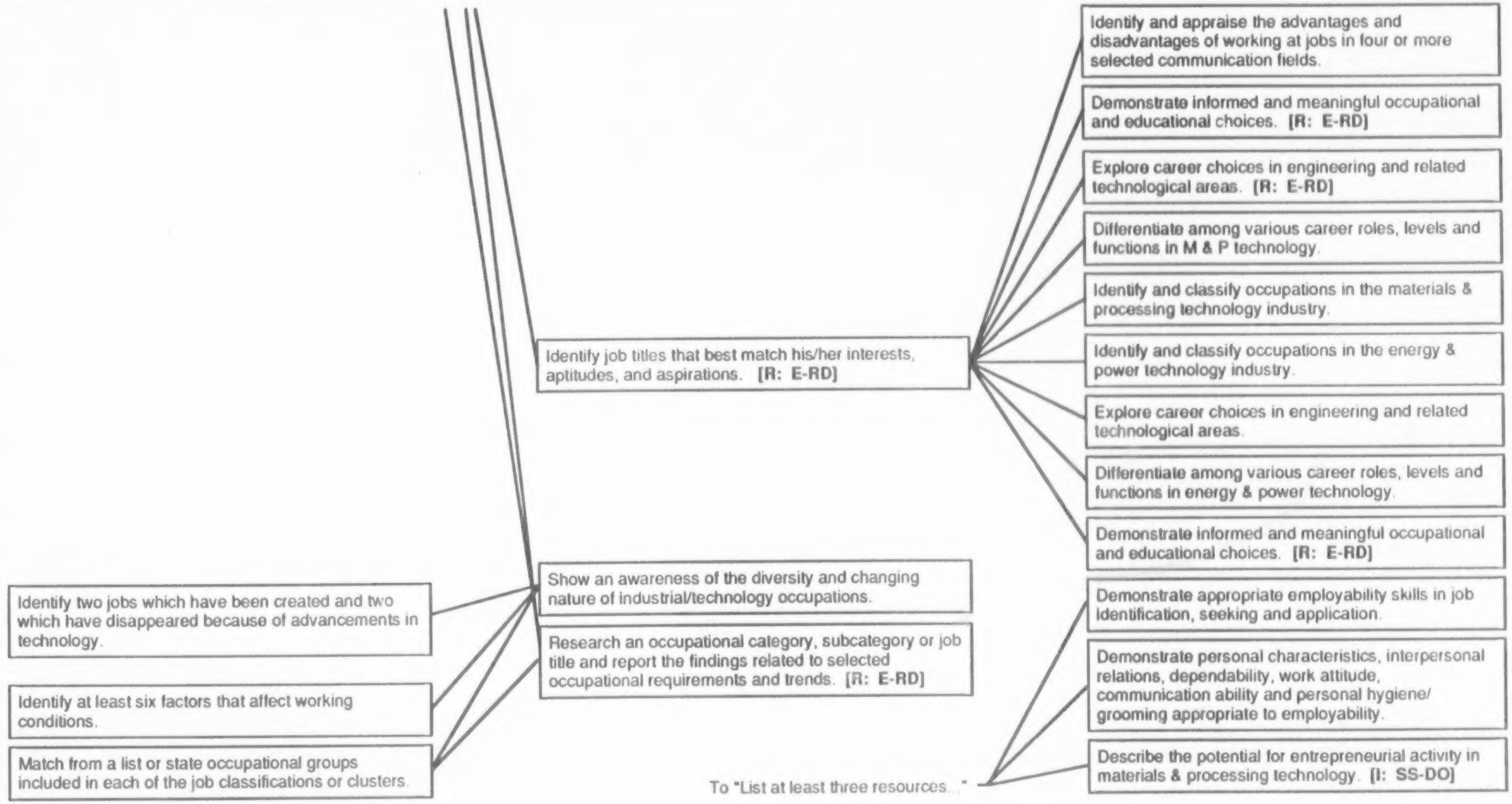
Complete in writing an interest or aptitude assessment scale and have it scored. **[R: E-WF]**

With the help of a guidance counselor, interpret the results of the assessment scale.

Strand #3: Careers

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Careers (continued)



Level 2 Introduction:

- Identify two jobs which have been created and two which have disappeared because of advancements in technology.
- Identify at least six factors that affect working conditions.
- Match from a list or state occupational groups included in each of the job classifications or clusters.

Level 2 Exploration:

- Identify job titles that best match his/her interests, aptitudes, and aspirations. **[R: E-RD]**
- Show an awareness of the diversity and changing nature of industrial/technology occupations.
- Research an occupational category, subcategory or job title and report the findings related to selected occupational requirements and trends. **[R: E-RD]**
- To "List at least three resources..."

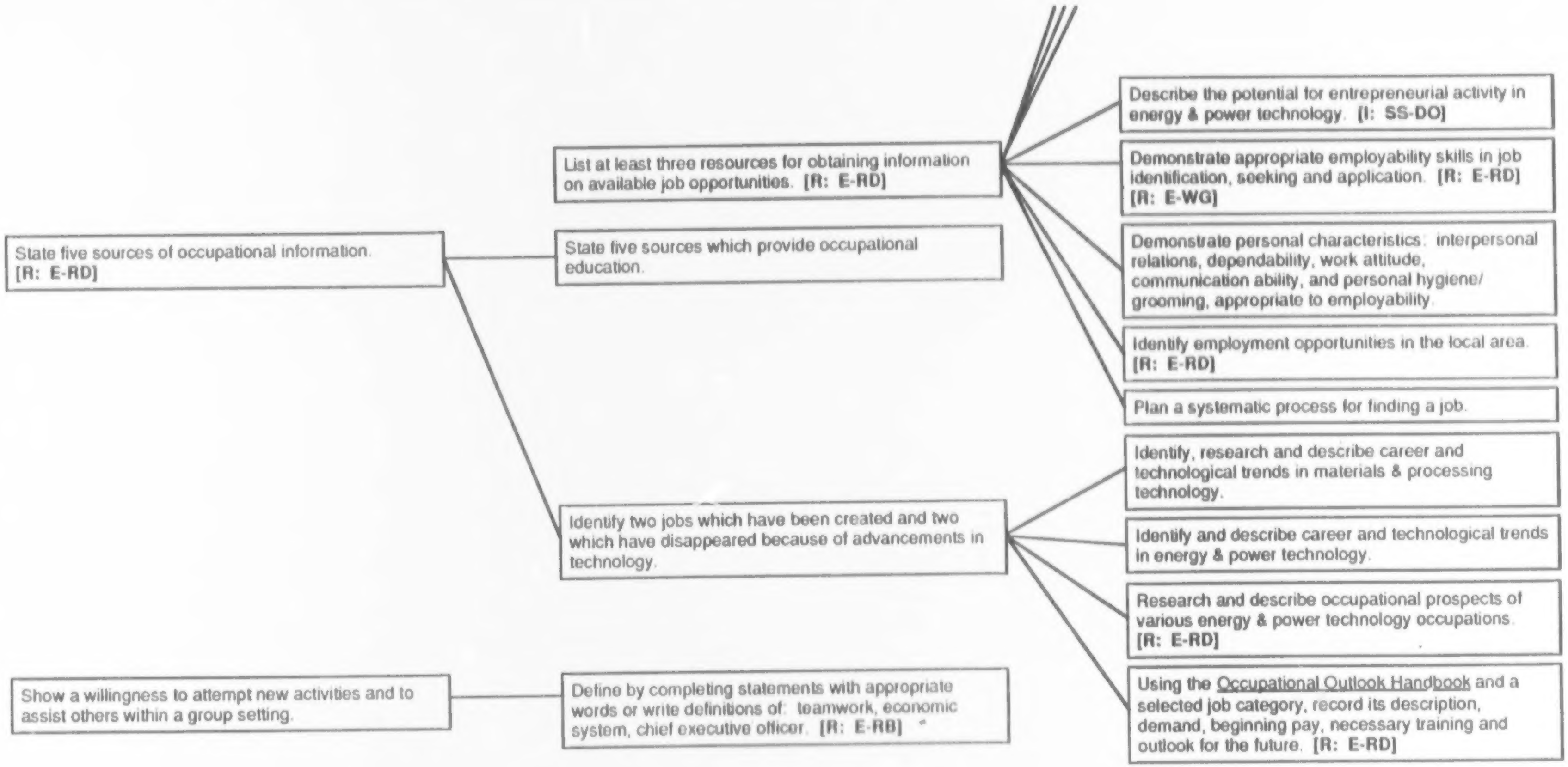
Level 3 Intermediate:

- Identify and appraise the advantages and disadvantages of working at jobs in four or more selected communication fields.
- Demonstrate informed and meaningful occupational and educational choices. **[R: E-RD]**
- Explore career choices in engineering and related technological areas. **[R: E-RD]**
- Differentiate among various career roles, levels and functions in M & P technology.
- Identify and classify occupations in the materials & processing technology industry.
- Identify and classify occupations in the energy & power technology industry.
- Explore career choices in engineering and related technological areas.
- Differentiate among various career roles, levels and functions in energy & power technology.
- Demonstrate informed and meaningful occupational and educational choices. **[R: E-RD]**
- Demonstrate appropriate employability skills in job identification, seeking and application.
- Demonstrate personal characteristics, interpersonal relations, dependability, work attitude, communication ability and personal hygiene/grooming appropriate to employability.
- Describe the potential for entrepreneurial activity in materials & processing technology. **[I: SS-DO]**

Strand #3: Careers

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Careers (continued)



State five sources of occupational information. **[R: E-RD]**

Show a willingness to attempt new activities and to assist others within a group setting.

List at least three resources for obtaining information on available job opportunities. **[R: E-RD]**

State five sources which provide occupational education.

Identify two jobs which have been created and two which have disappeared because of advancements in technology.

Define by completing statements with appropriate words or write definitions of: teamwork, economic system, chief executive officer. **[R: E-RB]**

Describe the potential for entrepreneurial activity in energy & power technology. **[I: SS-DO]**

Demonstrate appropriate employability skills in job identification, seeking and application. **[R: E-RD] [R: E-WG]**

Demonstrate personal characteristics: interpersonal relations, dependability, work attitude, communication ability, and personal hygiene/grooming, appropriate to employability.

Identify employment opportunities in the local area. **[R: E-RD]**

Plan a systematic process for finding a job.

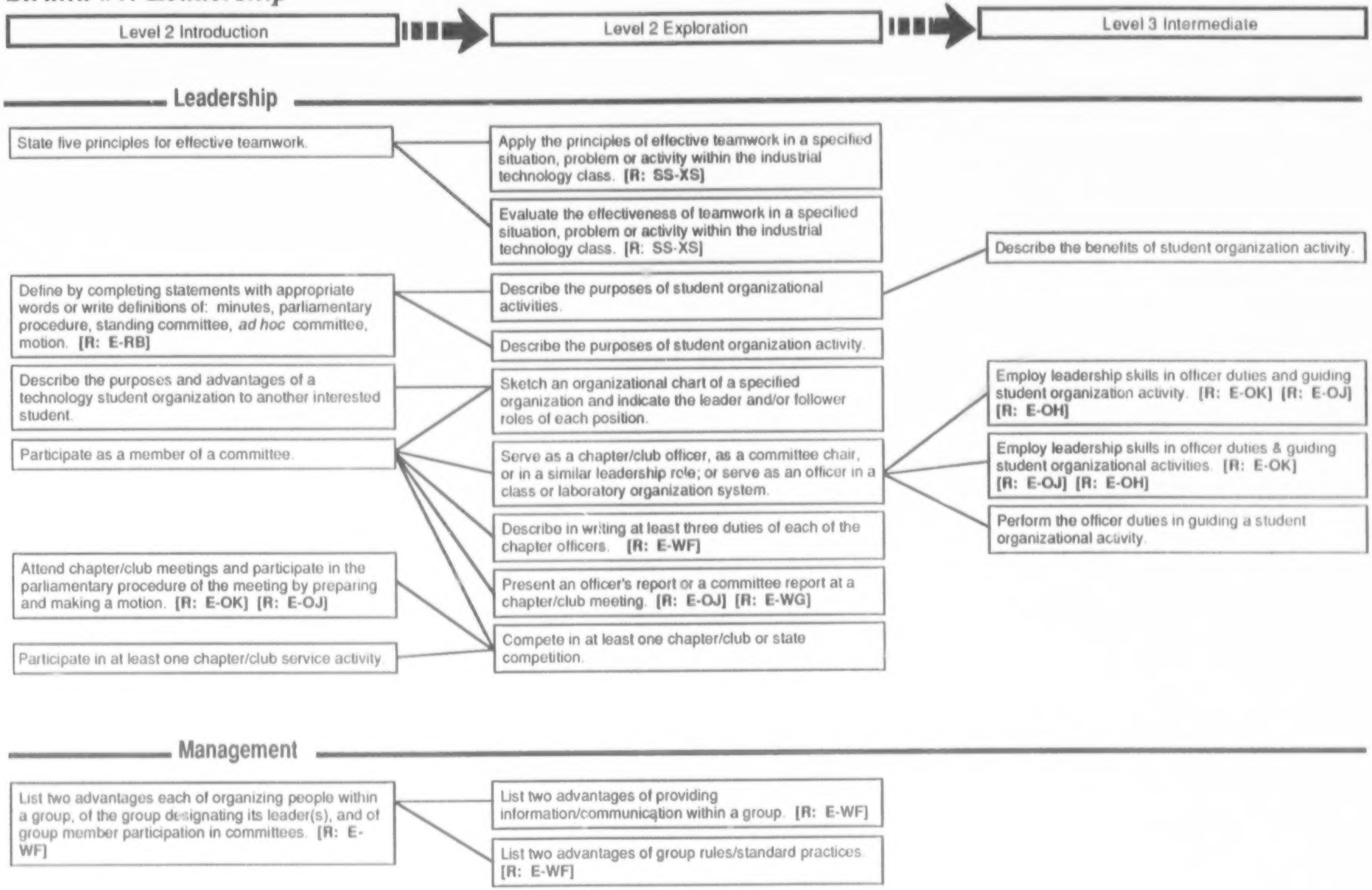
Identify, research and describe career and technological trends in materials & processing technology.

Identify and describe career and technological trends in energy & power technology.

Research and describe occupational prospects of various energy & power technology occupations. **[R: E-RD]**

Using the Occupational Outlook Handbook and a selected job category, record its description, demand, beginning pay, necessary training and outlook for the future. **[R: E-RD]**

Strand #4: Leadership



Level 2 Introduction

Level 2 Exploration

Level 3 Intermediate

Leadership

Level 2 Introduction

- State five principles for effective teamwork.
- Define by completing statements with appropriate words or write definitions of: minutes, parliamentary procedure, standing committee, *ad hoc* committee, motion. **[R: E-RB]**
- Describe the purposes and advantages of a technology student organization to another interested student.
- Participate as a member of a committee.
- Attend chapter/club meetings and participate in the parliamentary procedure of the meeting by preparing and making a motion. **[R: E-OK] [R: E-OJ]**
- Participate in at least one chapter/club service activity.

Level 2 Exploration

- Apply the principles of effective teamwork in a specified situation, problem or activity within the industrial technology class. **[R: SS-XS]**
- Evaluate the effectiveness of teamwork in a specified situation, problem or activity within the industrial technology class. **[R: SS-XS]**
- Describe the purposes of student organizational activities.
- Describe the purposes of student organization activity.
- Sketch an organizational chart of a specified organization and indicate the leader and/or follower roles of each position.
- Serve as a chapter/club officer, as a committee chair, or in a similar leadership role; or serve as an officer in a class or laboratory organization system.
- Describe in writing at least three duties of each of the chapter officers. **[R: E-WF]**
- Present an officer's report or a committee report at a chapter/club meeting. **[R: E-OJ] [R: E-WG]**
- Compete in at least one chapter/club or state competition.

Level 3 Intermediate

- Describe the benefits of student organization activity.
- Employ leadership skills in officer duties and guiding student organization activity. **[R: E-OK] [R: E-OJ] [R: E-OH]**
- Employ leadership skills in officer duties & guiding student organizational activities. **[R: E-OK] [R: E-OJ] [R: E-OH]**
- Perform the officer duties in guiding a student organizational activity.

Management

Level 2 Introduction

- List two advantages each of organizing people within a group, of the group designating its leader(s), and of group member participation in committees. **[R: E-WF]**

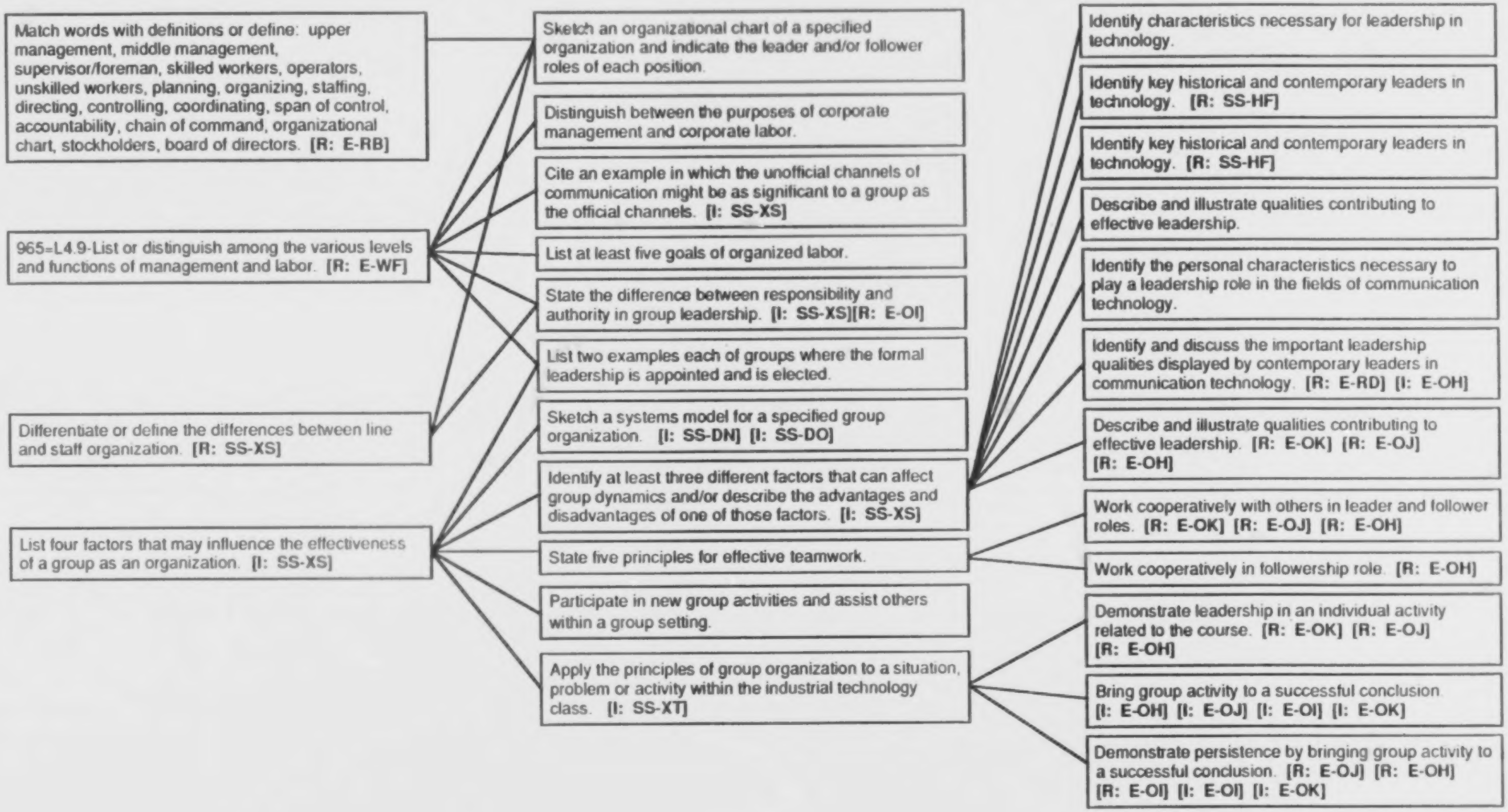
Level 2 Exploration

- List two advantages of providing information/communication within a group. **[R: E-WF]**
- List two advantages of group rules/standard practices. **[R: E-WF]**

Strand #4: Leadership

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Management (continued)



Level 2 Introduction

- Match words with definitions or define: upper management, middle management, supervisor/foreman, skilled workers, operators, unskilled workers, planning, organizing, staffing, directing, controlling, coordinating, span of control, accountability, chain of command, organizational chart, stockholders, board of directors. [R: E-RB]
- 965=L4.9-List or distinguish among the various levels and functions of management and labor. [R: E-WF]
- Differentiate or define the differences between line and staff organization. [R: SS-XS]
- List four factors that may influence the effectiveness of a group as an organization. [I: SS-XS]

Level 2 Exploration

- Sketch an organizational chart of a specified organization and indicate the leader and/or follower roles of each position.
- Distinguish between the purposes of corporate management and corporate labor.
- Cite an example in which the unofficial channels of communication might be as significant to a group as the official channels. [I: SS-XS]
- List at least five goals of organized labor.
- State the difference between responsibility and authority in group leadership. [I: SS-XS][R: E-OI]
- List two examples each of groups where the formal leadership is appointed and is elected.
- Sketch a systems model for a specified group organization. [I: SS-DN] [I: SS-DO]
- Identify at least three different factors that can affect group dynamics and/or describe the advantages and disadvantages of one of those factors. [I: SS-XS]
- State five principles for effective teamwork.
- Participate in new group activities and assist others within a group setting.
- Apply the principles of group organization to a situation, problem or activity within the industrial technology class. [I: SS-XT]

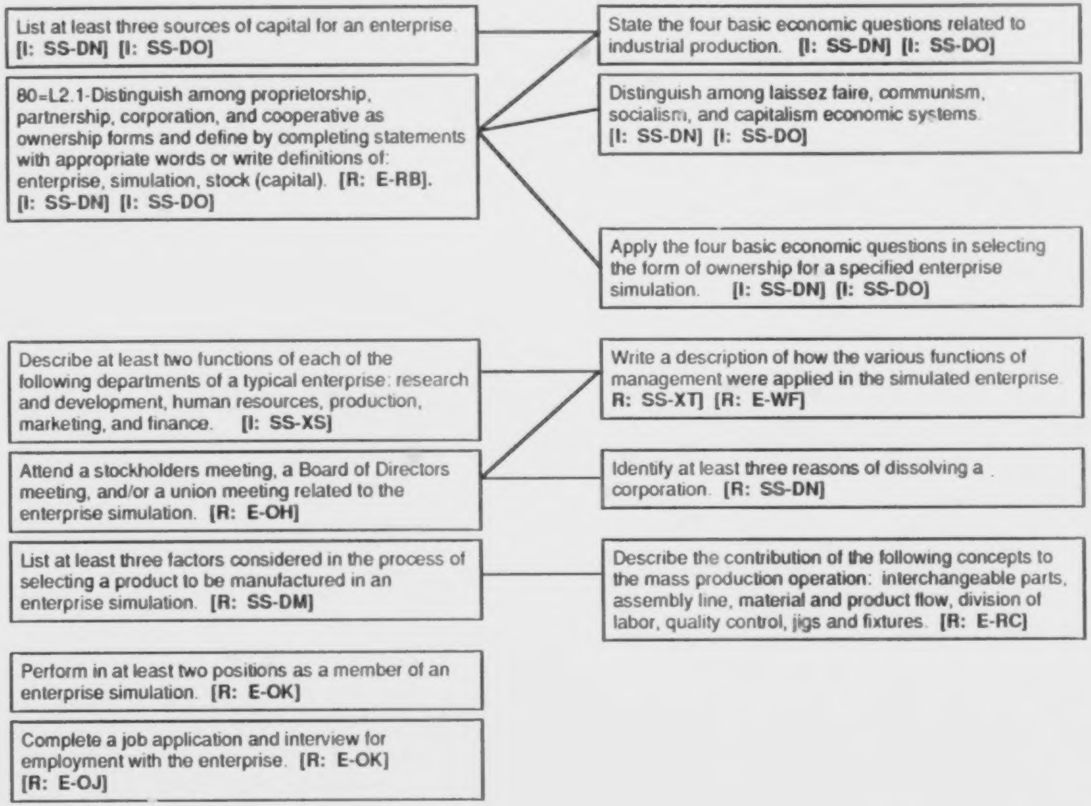
Level 3 Intermediate

- Identify characteristics necessary for leadership in technology.
- Identify key historical and contemporary leaders in technology. [R: SS-HF]
- Identify key historical and contemporary leaders in technology. [R: SS-HF]
- Describe and illustrate qualities contributing to effective leadership.
- Identify the personal characteristics necessary to play a leadership role in the fields of communication technology.
- Identify and discuss the important leadership qualities displayed by contemporary leaders in communication technology. [R: E-RD] [I: E-OH]
- Describe and illustrate qualities contributing to effective leadership. [R: E-OK] [R: E-OJ] [R: E-OH]
- Work cooperatively with others in leader and follower roles. [R: E-OK] [R: E-OJ] [R: E-OH]
- Work cooperatively in followership role. [R: E-OH]
- Demonstrate leadership in an individual activity related to the course. [R: E-OK] [R: E-OJ] [R: E-OH]
- Bring group activity to a successful conclusion. [I: E-OH] [I: E-OJ] [I: E-OI] [I: E-OK]
- Demonstrate persistence by bringing group activity to a successful conclusion. [R: E-OJ] [R: E-OH] [R: E-OI] [I: E-OI] [I: E-OK]

Strand #4: Leadership

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Management (continued)



Level 2 Introduction

List at least three sources of capital for an enterprise. **[I: SS-DN] [I: SS-DO]**

80=L2.1-Distinguish among proprietorship, partnership, corporation, and cooperative as ownership forms and define by completing statements with appropriate words or write definitions of: enterprise, simulation, stock (capital). **[R: E-RB].** **[I: SS-DN] [I: SS-DO]**

Describe at least two functions of each of the following departments of a typical enterprise: research and development, human resources, production, marketing, and finance. **[I: SS-XS]**

Attend a stockholders meeting, a Board of Directors meeting, and/or a union meeting related to the enterprise simulation. **[R: E-OH]**

List at least three factors considered in the process of selecting a product to be manufactured in an enterprise simulation. **[R: SS-DM]**

Perform in at least two positions as a member of an enterprise simulation. **[R: E-OK]**

Complete a job application and interview for employment with the enterprise. **[R: E-OK]** **[R: E-OJ]**

Level 2 Exploration

State the four basic economic questions related to industrial production. **[I: SS-DN] [I: SS-DO]**

Distinguish among laissez faire, communism, socialism, and capitalism economic systems. **[I: SS-DN] [I: SS-DO]**

Apply the four basic economic questions in selecting the form of ownership for a specified enterprise simulation. **[I: SS-DN] [I: SS-DO]**

Write a description of how the various functions of management were applied in the simulated enterprise. **R: SS-XT] [R: E-WF]**

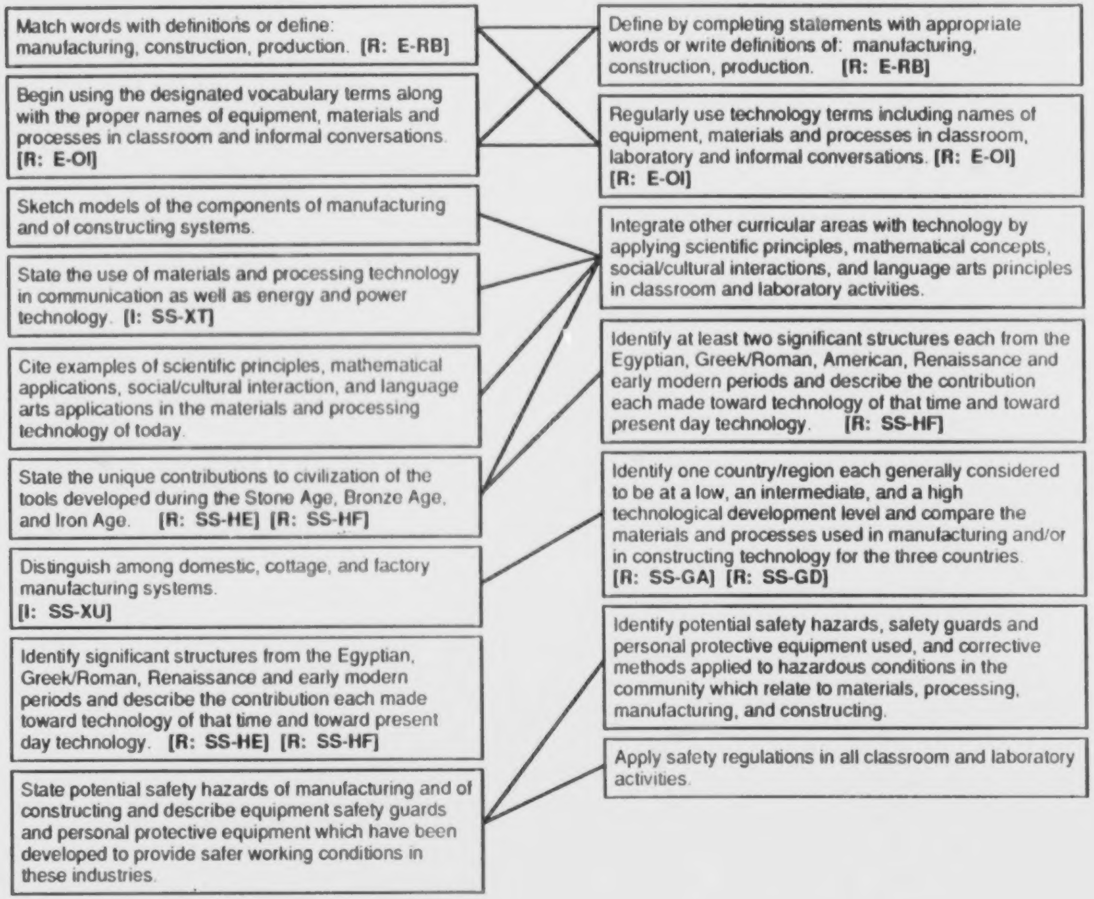
Identify at least three reasons of dissolving a corporation. **[R: SS-DN]**

Describe the contribution of the following concepts to the mass production operation: interchangeable parts, assembly line, material and product flow, division of labor, quality control, jigs and fixtures. **[R: E-RC]**

Strand #5: Materials & Processing Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Overview



Match words with definitions or define: manufacturing, construction, production. **[R: E-RB]**

Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-OI]**

Sketch models of the components of manufacturing and of constructing systems.

State the use of materials and processing technology in communication as well as energy and power technology. **[I: SS-XT]**

Cite examples of scientific principles, mathematical applications, social/cultural interaction, and language arts applications in the materials and processing technology of today.

State the unique contributions to civilization of the tools developed during the Stone Age, Bronze Age, and Iron Age. **[R: SS-HE] [R: SS-HF]**

Distinguish among domestic, cottage, and factory manufacturing systems. **[I: SS-XU]**

Identify significant structures from the Egyptian, Greek/Roman, Renaissance and early modern periods and describe the contribution each made toward technology of that time and toward present day technology. **[R: SS-HE] [R: SS-HF]**

State potential safety hazards of manufacturing and of constructing and describe equipment safety guards and personal protective equipment which have been developed to provide safer working conditions in these industries.

Define by completing statements with appropriate words or write definitions of: manufacturing, construction, production. **[R: E-RB]**

Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-OI]** **[R: E-OI]**

Integrate other curricular areas with technology by applying scientific principles, mathematical concepts, social/cultural interactions, and language arts principles in classroom and laboratory activities.

Identify at least two significant structures each from the Egyptian, Greek/Roman, American, Renaissance and early modern periods and describe the contribution each made toward technology of that time and toward present day technology. **[R: SS-HF]**

Identify one country/region each generally considered to be at a low, an intermediate, and a high technological development level and compare the materials and processes used in manufacturing and/or in constructing technology for the three countries. **[R: SS-GA] [R: SS-GD]**

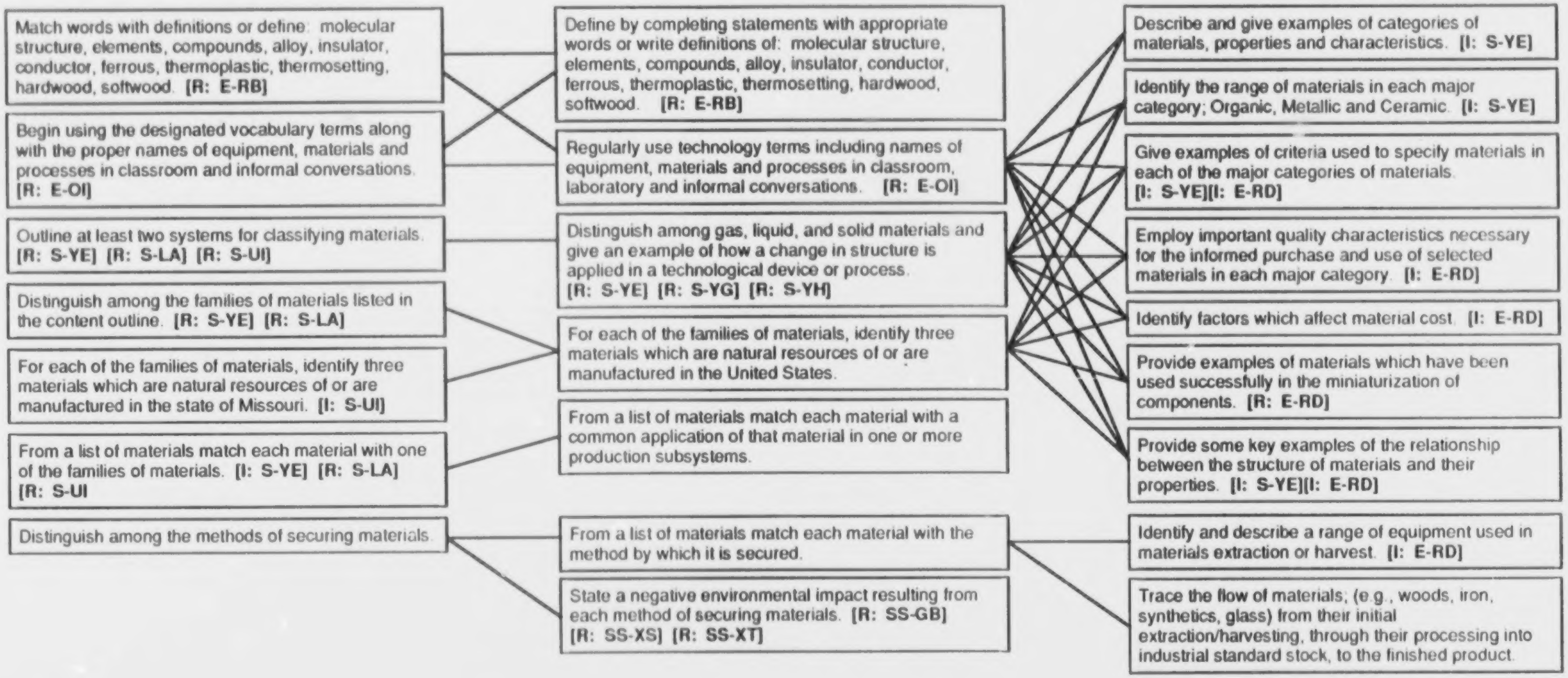
Identify potential safety hazards, safety guards and personal protective equipment used, and corrective methods applied to hazardous conditions in the community which relate to materials, processing, manufacturing, and constructing.

Apply safety regulations in all classroom and laboratory activities.

Strand #5: Materials & Processing Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Materials



Match words with definitions or define: molecular structure, elements, compounds, alloy, insulator, conductor, ferrous, thermoplastic, thermosetting, hardwood, softwood. **[R: E-RB]**

Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-OI]**

Outline at least two systems for classifying materials. **[R: S-YE] [R: S-LA] [R: S-UI]**

Distinguish among the families of materials listed in the content outline. **[R: S-YE] [R: S-LA]**

For each of the families of materials, identify three materials which are natural resources of or are manufactured in the state of Missouri. **[I: S-UI]**

From a list of materials match each material with one of the families of materials. **[I: S-YE] [R: S-LA] [R: S-UI**

Distinguish among the methods of securing materials.

Define by completing statements with appropriate words or write definitions of: molecular structure, elements, compounds, alloy, insulator, conductor, ferrous, thermoplastic, thermosetting, hardwood, softwood. **[R: E-RB]**

Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-OI]**

Distinguish among gas, liquid, and solid materials and give an example of how a change in structure is applied in a technological device or process. **[R: S-YE] [R: S-YG] [R: S-YH]**

For each of the families of materials, identify three materials which are natural resources of or are manufactured in the United States.

From a list of materials match each material with a common application of that material in one or more production subsystems.

From a list of materials match each material with the method by which it is secured.

State a negative environmental impact resulting from each method of securing materials. **[R: SS-GB] [R: SS-XS] [R: SS-XT]**

Describe and give examples of categories of materials, properties and characteristics. **[I: S-YE]**

Identify the range of materials in each major category; Organic, Metallic and Ceramic. **[I: S-YE]**

Give examples of criteria used to specify materials in each of the major categories of materials. **[I: S-YE][I: E-RD]**

Employ important quality characteristics necessary for the informed purchase and use of selected materials in each major category. **[I: E-RD]**

Identify factors which affect material cost. **[I: E-RD]**

Provide examples of materials which have been used successfully in the miniaturization of components. **[R: E-RD]**

Provide some key examples of the relationship between the structure of materials and their properties. **[I: S-YE][I: E-RD]**

Identify and describe a range of equipment used in materials extraction or harvest. **[I: E-RD]**

Trace the flow of materials; (e.g., woods, iron, synthetics, glass) from their initial extraction/harvesting, through their processing into industrial standard stock, to the finished product.

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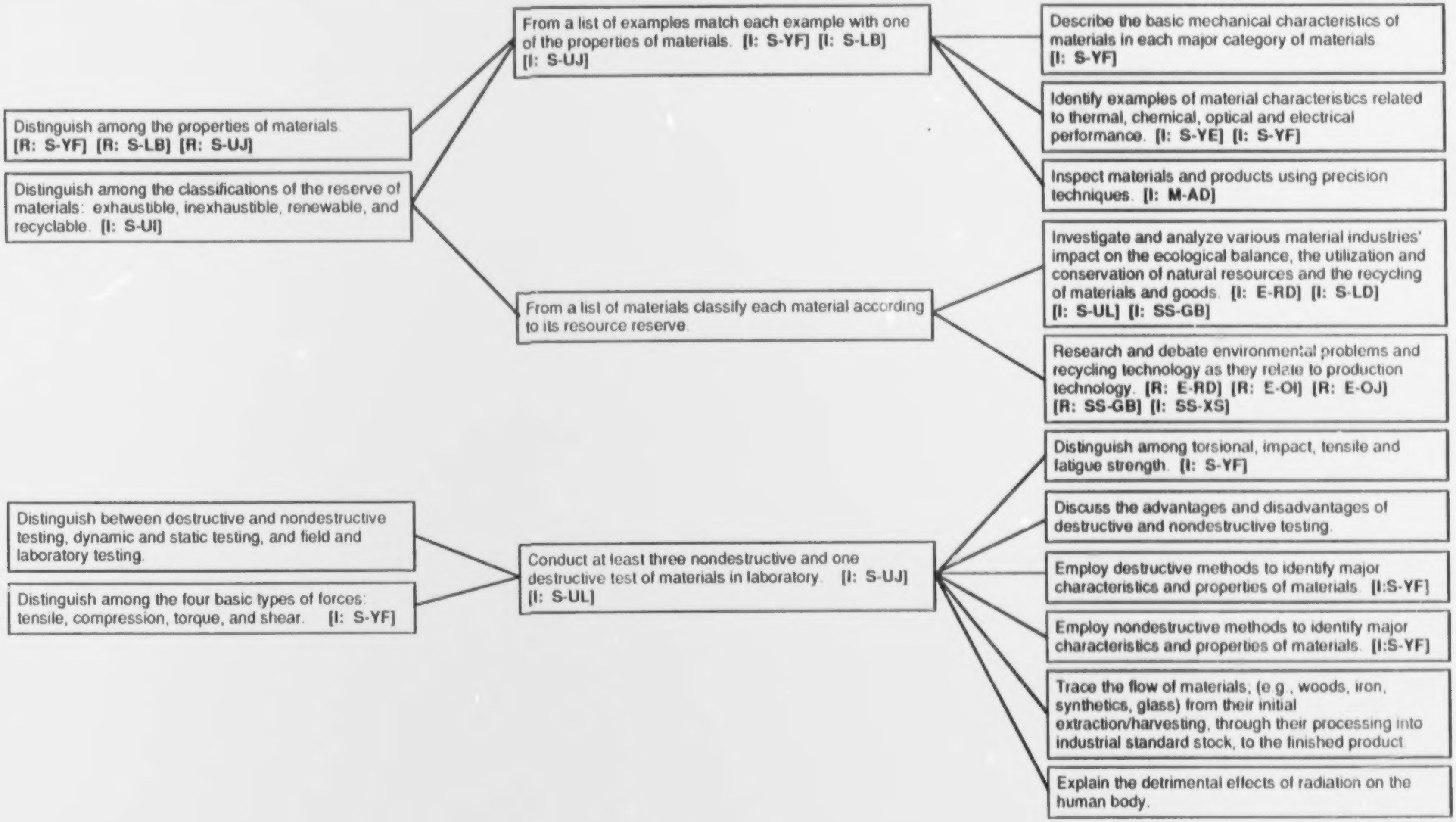
Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Materials (continued)



Level 2 Introduction

Distinguish among the properties of materials. [R: S-YF] [R: S-LB] [R: S-UJ]

Distinguish among the classifications of the reserve of materials: exhaustible, inexhaustible, renewable, and recyclable. [I: S-UI]

Distinguish between destructive and nondestructive testing, dynamic and static testing, and field and laboratory testing.

Distinguish among the four basic types of forces: tensile, compression, torque, and shear. [I: S-YF]

Level 2 Exploration

From a list of examples match each example with one of the properties of materials. [I: S-YF] [I: S-LB] [I: S-UJ]

From a list of materials classify each material according to its resource reserve.

Conduct at least three nondestructive and one destructive test of materials in laboratory. [I: S-UJ] [I: S-UL]

Level 3 Intermediate

Describe the basic mechanical characteristics of materials in each major category of materials [I: S-YF]

Identify examples of material characteristics related to thermal, chemical, optical and electrical performance. [I: S-YE] [I: S-YF]

Inspect materials and products using precision techniques. [I: M-AD]

Investigate and analyze various material industries' impact on the ecological balance, the utilization and conservation of natural resources and the recycling of materials and goods. [I: E-RD] [I: S-LD] [I: S-UL] [I: SS-GB]

Research and debate environmental problems and recycling technology as they relate to production technology. [R: E-RD] [R: E-OI] [R: E-OJ] [R: SS-GB] [I: SS-XS]

Distinguish among torsional, impact, tensile and fatigue strength. [I: S-YF]

Discuss the advantages and disadvantages of destructive and nondestructive testing.

Employ destructive methods to identify major characteristics and properties of materials. [I:S-YF]

Employ nondestructive methods to identify major characteristics and properties of materials. [I:S-YF]

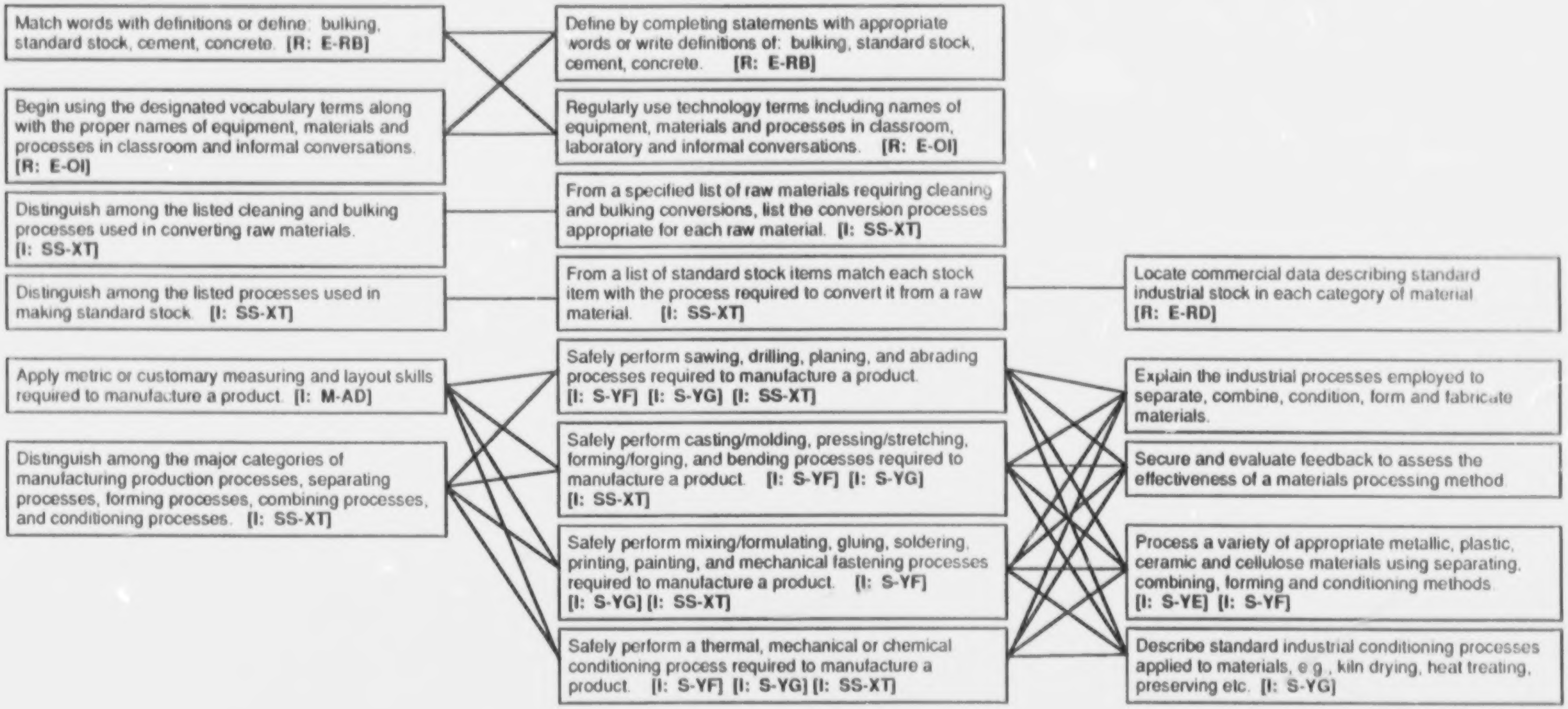
Trace the flow of materials; (e.g., woods, iron, synthetics, glass) from their initial extraction/harvesting, through their processing into industrial standard stock, to the finished product.

Explain the detrimental effects of radiation on the human body.

Strand #5: Materials & Processing Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Processing



Level 2 Introduction

- Match words with definitions or define: bulking, standard stock, cement, concrete. **[R: E-RB]**
- Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-OI]**
- Distinguish among the listed cleaning and bulking processes used in converting raw materials. **[I: SS-XT]**
- Distinguish among the listed processes used in making standard stock. **[I: SS-XT]**
- Apply metric or customary measuring and layout skills required to manufacture a product. **[I: M-AD]**
- Distinguish among the major categories of manufacturing production processes, separating processes, forming processes, combining processes, and conditioning processes. **[I: SS-XT]**

Level 2 Exploration

- Define by completing statements with appropriate words or write definitions of: bulking, standard stock, cement, concrete. **[R: E-RB]**
- Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-OI]**
- From a specified list of raw materials requiring cleaning and bulking conversions, list the conversion processes appropriate for each raw material. **[I: SS-XT]**
- From a list of standard stock items match each stock item with the process required to convert it from a raw material. **[I: SS-XT]**
- Safely perform sawing, drilling, planing, and abrading processes required to manufacture a product. **[I: S-YF] [I: S-YG] [I: SS-XT]**
- Safely perform casting/molding, pressing/stretching, forming/forging, and bending processes required to manufacture a product. **[I: S-YF] [I: S-YG] [I: SS-XT]**
- Safely perform mixing/formulating, gluing, soldering, printing, painting, and mechanical fastening processes required to manufacture a product. **[I: S-YF] [I: S-YG] [I: SS-XT]**
- Safely perform a thermal, mechanical or chemical conditioning process required to manufacture a product. **[I: S-YF] [I: S-YG] [I: SS-XT]**

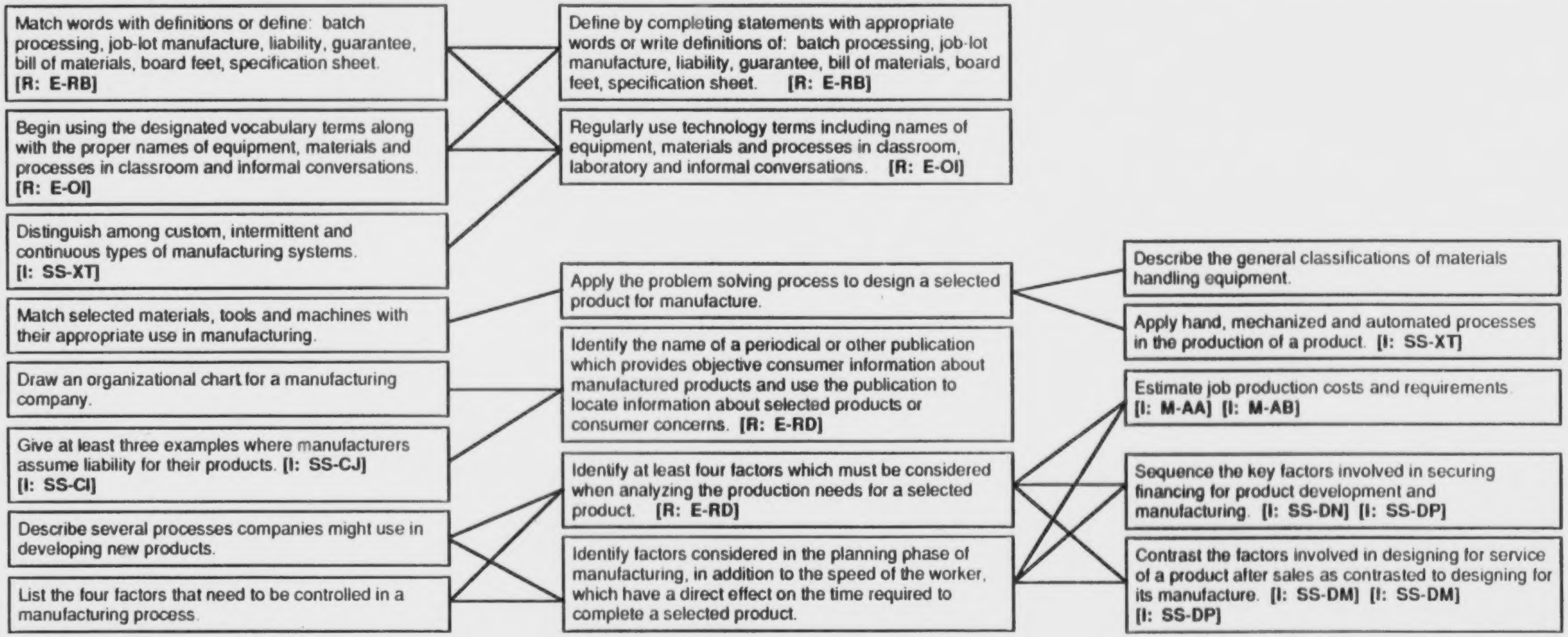
Level 3 Intermediate

- Locate commercial data describing standard industrial stock in each category of material. **[R: E-RD]**
- Explain the industrial processes employed to separate, combine, condition, form and fabricate materials.
- Secure and evaluate feedback to assess the effectiveness of a materials processing method.
- Process a variety of appropriate metallic, plastic, ceramic and cellulose materials using separating, combining, forming and conditioning methods. **[I: S-YE] [I: S-YF]**
- Describe standard industrial conditioning processes applied to materials, e.g., kiln drying, heat treating, preserving etc. **[I: S-YG]**

Strand #5: Materials & Processing Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Pre-manufacturing-Input



Level 2 Introduction

- Match words with definitions or define: batch processing, job-lot manufacture, liability, guarantee, bill of materials, board feet, specification sheet. **[R: E-RB]**
- Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-OI]**
- Distinguish among custom, intermittent and continuous types of manufacturing systems. **[I: SS-XT]**
- Match selected materials, tools and machines with their appropriate use in manufacturing.
- Draw an organizational chart for a manufacturing company.
- Give at least three examples where manufacturers assume liability for their products. **[I: SS-CJ] [I: SS-CI]**
- Describe several processes companies might use in developing new products.
- List the four factors that need to be controlled in a manufacturing process.

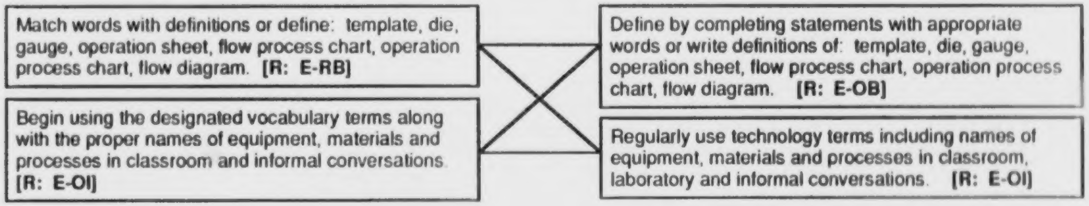
Level 2 Exploration

- Define by completing statements with appropriate words or write definitions of: batch processing, job-lot manufacture, liability, guarantee, bill of materials, board feet, specification sheet. **[R: E-RB]**
- Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-OI]**
- Apply the problem solving process to design a selected product for manufacture.
- Identify the name of a periodical or other publication which provides objective consumer information about manufactured products and use the publication to locate information about selected products or consumer concerns. **[R: E-RD]**
- Identify at least four factors which must be considered when analyzing the production needs for a selected product. **[R: E-RD]**
- Identify factors considered in the planning phase of manufacturing, in addition to the speed of the worker, which have a direct effect on the time required to complete a selected product.

Level 3 Intermediate

- Describe the general classifications of materials handling equipment.
- Apply hand, mechanized and automated processes in the production of a product. **[I: SS-XT]**
- Estimate job production costs and requirements. **[I: M-AA] [I: M-AB]**
- Sequence the key factors involved in securing financing for product development and manufacturing. **[I: SS-DN] [I: SS-DP]**
- Contrast the factors involved in designing for service of a product after sales as contrasted to designing for its manufacture. **[I: SS-DM] [I: SS-DM] [I: SS-DP]**

Manufacturing

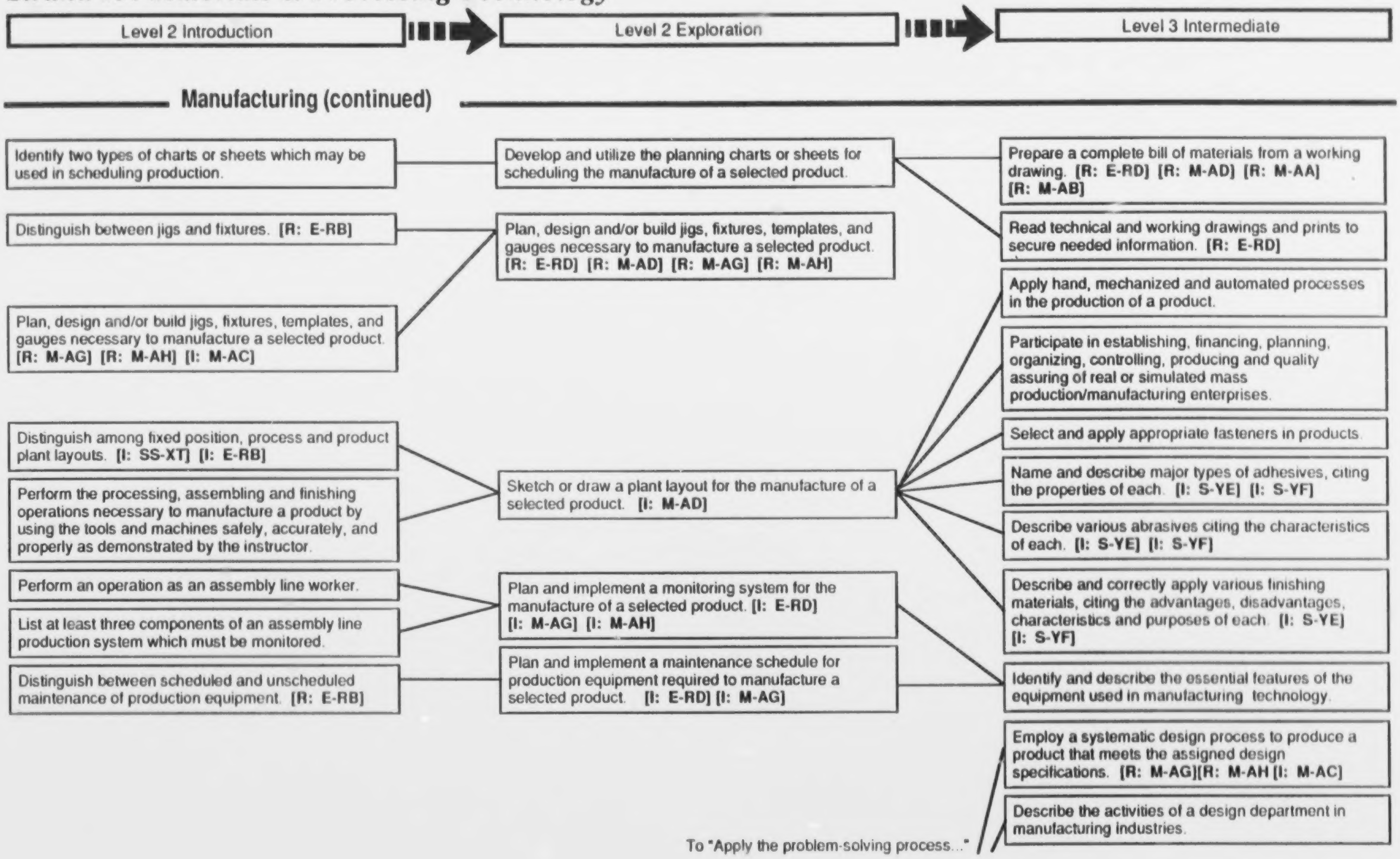


Level 2 Introduction

- Match words with definitions or define: template, die, gauge, operation sheet, flow process chart, operation process chart, flow diagram. **[R: E-RB]**
- Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-OI]**

Level 2 Exploration

- Define by completing statements with appropriate words or write definitions of: template, die, gauge, operation sheet, flow process chart, operation process chart, flow diagram. **[R: E-OB]**
- Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-OI]**



Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Manufacturing (continued)

Level 2 Introduction

- Identify two types of charts or sheets which may be used in scheduling production.
- Distinguish between jigs and fixtures. [R: E-RB]
- Plan, design and/or build jigs, fixtures, templates, and gauges necessary to manufacture a selected product. [R: M-AG] [R: M-AH] [I: M-AC]
- Distinguish among fixed position, process and product plant layouts. [I: SS-XT] [I: E-RB]
- Perform the processing, assembling and finishing operations necessary to manufacture a product by using the tools and machines safely, accurately, and properly as demonstrated by the instructor.
- Perform an operation as an assembly line worker.
- List at least three components of an assembly line production system which must be monitored.
- Distinguish between scheduled and unscheduled maintenance of production equipment. [R: E-RB]

Level 2 Exploration

- Develop and utilize the planning charts or sheets for scheduling the manufacture of a selected product.
- Plan, design and/or build jigs, fixtures, templates, and gauges necessary to manufacture a selected product. [R: E-RD] [R: M-AD] [R: M-AG] [R: M-AH]
- Sketch or draw a plant layout for the manufacture of a selected product. [I: M-AD]
- Plan and implement a monitoring system for the manufacture of a selected product. [I: E-RD] [I: M-AG] [I: M-AH]
- Plan and implement a maintenance schedule for production equipment required to manufacture a selected product. [I: E-RD] [I: M-AG]

Level 3 Intermediate

- Prepare a complete bill of materials from a working drawing. [R: E-RD] [R: M-AD] [R: M-AA] [R: M-AB]
- Read technical and working drawings and prints to secure needed information. [R: E-RD]
- Apply hand, mechanized and automated processes in the production of a product.
- Participate in establishing, financing, planning, organizing, controlling, producing and quality assuring of real or simulated mass production/manufacturing enterprises.
- Select and apply appropriate fasteners in products.
- Name and describe major types of adhesives, citing the properties of each. [I: S-YE] [I: S-YF]
- Describe various abrasives citing the characteristics of each. [I: S-YE] [I: S-YF]
- Describe and correctly apply various finishing materials, citing the advantages, disadvantages, characteristics and purposes of each. [I: S-YE] [I: S-YF]
- Identify and describe the essential features of the equipment used in manufacturing technology.
- Employ a systematic design process to produce a product that meets the assigned design specifications. [R: M-AG][R: M-AH [I: M-AC]
- Describe the activities of a design department in manufacturing industries.

To "Apply the problem-solving process..."

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Manufacturing (continued)

Level 2 Introduction	Level 2 Exploration	Level 3 Intermediate
Apply the problem solving process to design a selected product for manufacture. **[R: M-AG] [R: M-AH] [I: M-AC]**	Apply the problem solving process to design a selected product for manufacture. **[R: M-AG]**	Solve simulated industrial design or planning problems in the production of a product. **[R: M-AG] [R: M-AH] [I: M-AC]**
		Evaluate manufactured products in terms of appropriateness of material, function of design, effectiveness of purpose as well as quality of construction. **[I: M-AC]**
		Describe and simulate the activities of a research and development department in bringing out a new product. **[I: M-AC] [I: M-AH] [I: M-AH]**
		Use symbols, lettering & production standards as published by trade and government organizations. **[R: E-RD]**
		Employ conventional drafting techniques to produce production drawings that meet appropriate standards. **[I: E-RD] [I: M-AD]**
		Employ CAD techniques and equipment to produce drawings or other output that meets appropriate standards. **[I: E-RD] [I: M-AD]**
		Apply standard industrial quality control procedures to items produced in the laboratory or constructed on site.

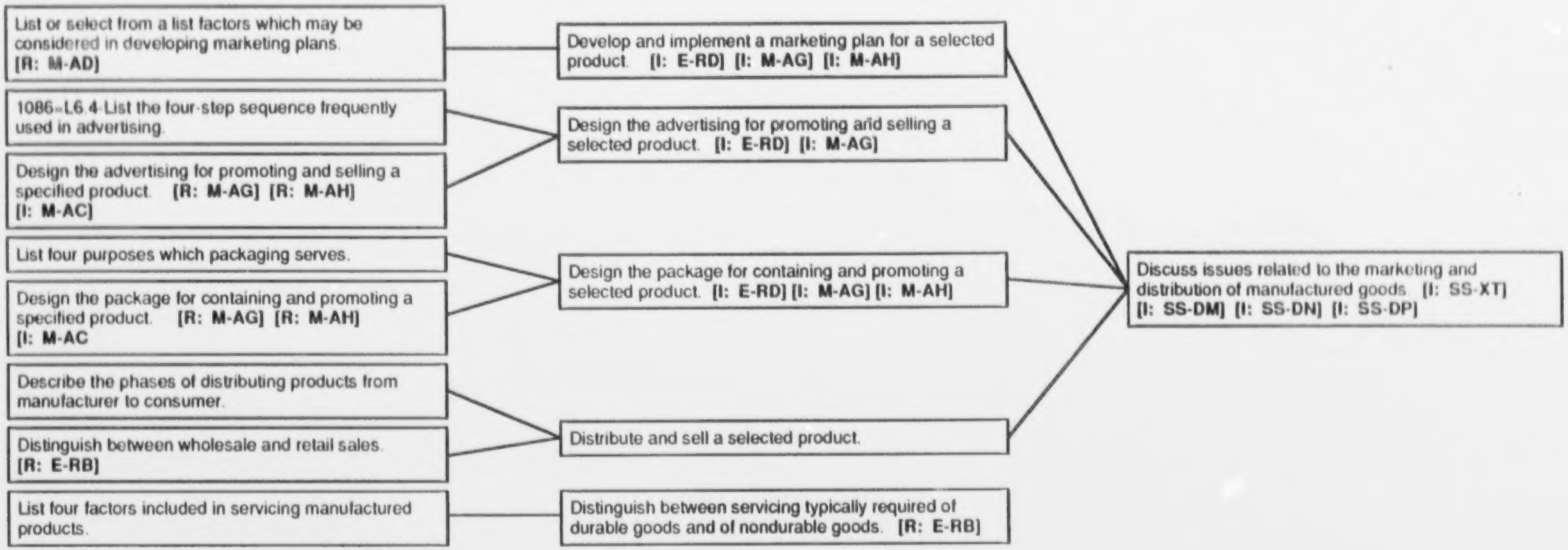
Post-manufacturing

Level 2 Introduction	Level 2 Exploration	Level 3 Intermediate
Match words with definitions or define: maintenance, diagnosis, repair, pallet, skid, marketing, distribution, promotion. **[R: E-RB]**	Define by completing statements with appropriate words or write definitions of: maintenance, diagnosis, repair, pallet, skid, marketing, distribution, promotion. **[R: E-OB]**	
Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-OI]**	Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-OB]**	

Strand #5: Materials & Processing Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Post-manufacturing (continued)



Level 2 Introduction:

- List or select from a list factors which may be considered in developing marketing plans. **[R: M-AD]**
- 1086=L6.4 List the four-step sequence frequently used in advertising.
- Design the advertising for promoting and selling a specified product. **[R: M-AG] [R: M-AH] [I: M-AC]**
- List four purposes which packaging serves.
- Design the package for containing and promoting a specified product. **[R: M-AG] [R: M-AH] [I: M-AC**
- Describe the phases of distributing products from manufacturer to consumer.
- Distinguish between wholesale and retail sales. **[R: E-RB]**
- List four factors included in servicing manufactured products.

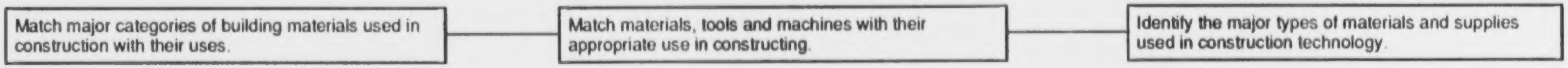
Level 2 Exploration:

- Develop and implement a marketing plan for a selected product. **[I: E-RD] [I: M-AG] [I: M-AH]**
- Design the advertising for promoting and selling a selected product. **[I: E-RD] [I: M-AG]**
- Design the package for containing and promoting a selected product. **[I: E-RD] [I: M-AG] [I: M-AH]**
- Distribute and sell a selected product.
- Distinguish between servicing typically required of durable goods and of nondurable goods. **[R: E-RB]**

Level 3 Intermediate:

- Discuss issues related to the marketing and distribution of manufactured goods. **[I: SS-XT] [I: SS-DM] [I: SS-DN] [I: SS-DP]**

Pre-construction



- Match major categories of building materials used in construction with their uses.
- Match materials, tools and machines with their appropriate use in constructing.
- Identify the major types of materials and supplies used in construction technology.

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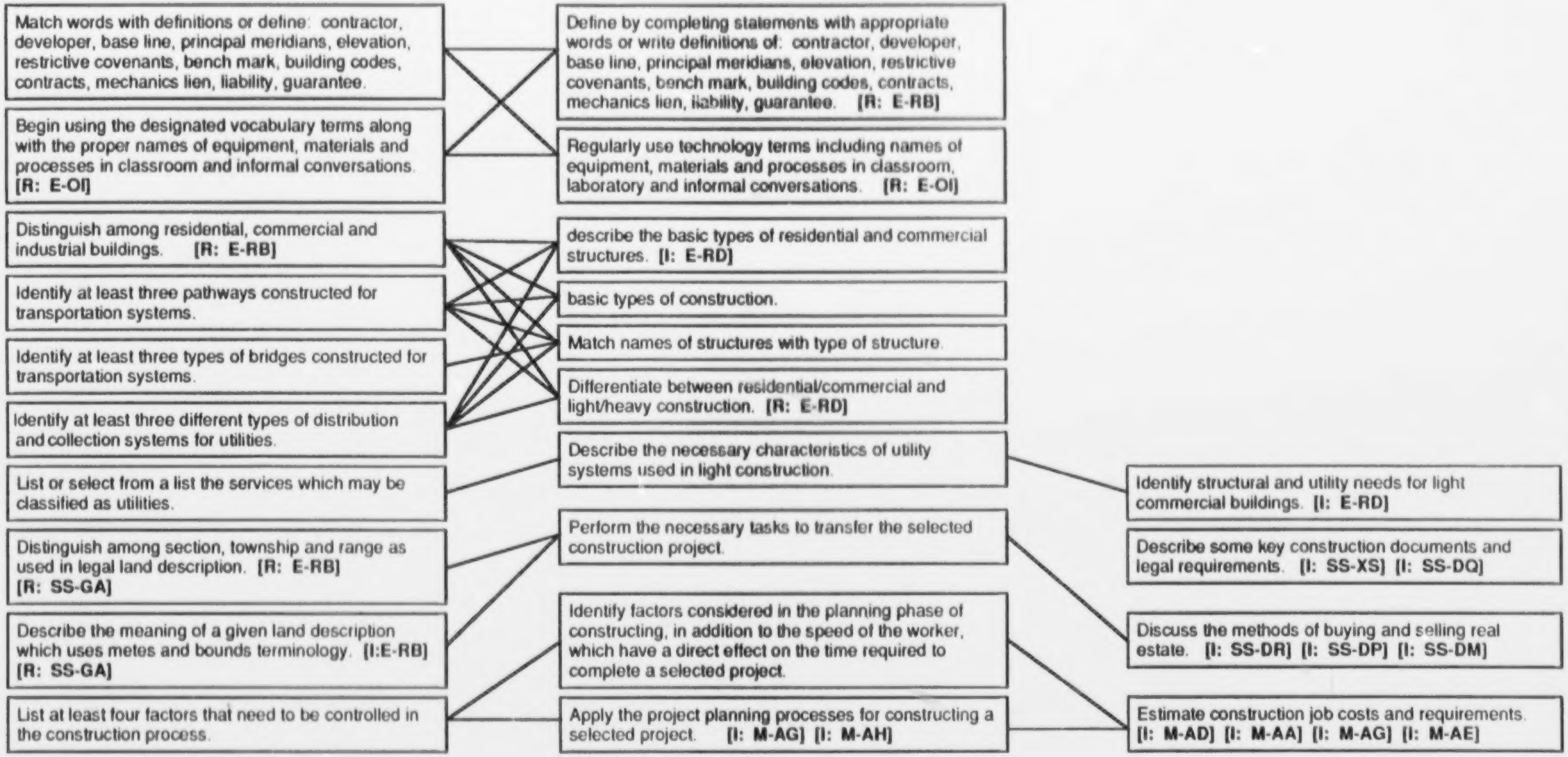
Strand #5: Materials & Processing Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Pre-construction (continued)



Level 2 Introduction

- Match words with definitions or define: contractor, developer, base line, principal meridians, elevation, restrictive covenants, bench mark, building codes, contracts, mechanics lien, liability, guarantee.
- Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. [R: E-OI]
- Distinguish among residential, commercial and industrial buildings. [R: E-RB]
- Identify at least three pathways constructed for transportation systems.
- Identify at least three types of bridges constructed for transportation systems.
- Identify at least three different types of distribution and collection systems for utilities.
- List or select from a list the services which may be classified as utilities.
- Distinguish among section, township and range as used in legal land description. [R: E-RB] [R: SS-GA]
- Describe the meaning of a given land description which uses metes and bounds terminology. [I:E-RB] [R: SS-GA]
- List at least four factors that need to be controlled in the construction process.

Level 2 Exploration

- Define by completing statements with appropriate words or write definitions of: contractor, developer, base line, principal meridians, elevation, restrictive covenants, bench mark, building codes, contracts, mechanics lien, liability, guarantee. [R: E-RB]
- Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. [R: E-OI]
- describe the basic types of residential and commercial structures. [I: E-RD]
- basic types of construction.
- Match names of structures with type of structure.
- Differentiate between residential/commercial and light/heavy construction. [R: E-RD]
- Describe the necessary characteristics of utility systems used in light construction.
- Perform the necessary tasks to transfer the selected construction project.
- Identify factors considered in the planning phase of constructing, in addition to the speed of the worker, which have a direct effect on the time required to complete a selected project.
- Apply the project planning processes for constructing a selected project. [I: M-AG] [I: M-AH]

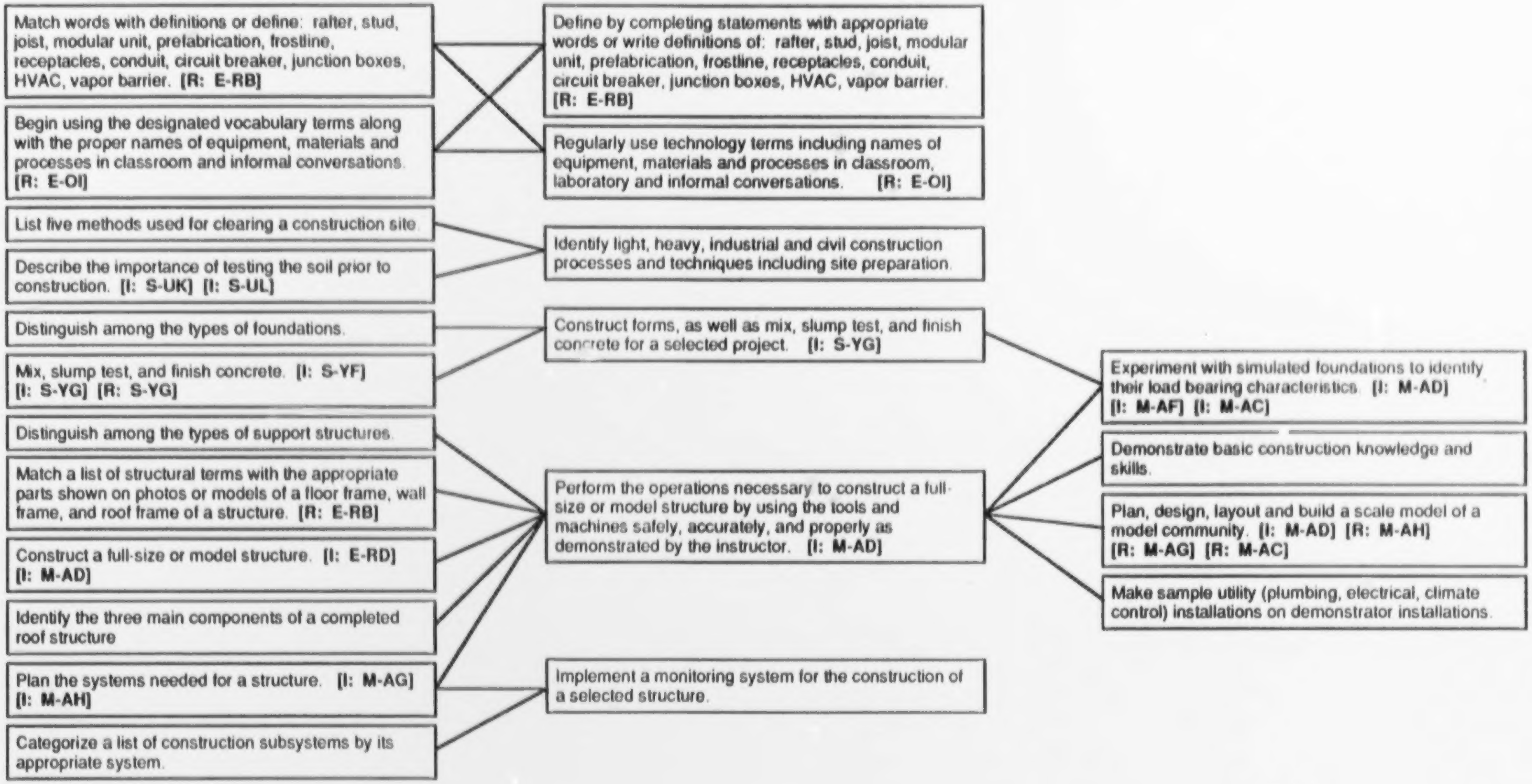
Level 3 Intermediate

- Identify structural and utility needs for light commercial buildings. [I: E-RD]
- Describe some key construction documents and legal requirements. [I: SS-XS] [I: SS-DQ]
- Discuss the methods of buying and selling real estate. [I: SS-DR] [I: SS-DP] [I: SS-DM]
- Estimate construction job costs and requirements. [I: M-AD] [I: M-AA] [I: M-AG] [I: M-AE]

Strand #5: Materials & Processing Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Construction



Level 2 Introduction

Match words with definitions or define: rafter, stud, joist, modular unit, prefabrication, frostline, receptacles, conduit, circuit breaker, junction boxes, HVAC, vapor barrier. **[R: E-RB]**

Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-OI]**

List five methods used for clearing a construction site.

Describe the importance of testing the soil prior to construction. **[I: S-UK] [I: S-UL]**

Distinguish among the types of foundations.

Mix, slump test, and finish concrete. **[I: S-YF] [I: S-YG] [R: S-YG]**

Distinguish among the types of support structures.

Match a list of structural terms with the appropriate parts shown on photos or models of a floor frame, wall frame, and roof frame of a structure. **[R: E-RB]**

Construct a full-size or model structure. **[I: E-RD] [I: M-AD]**

Identify the three main components of a completed roof structure

Plan the systems needed for a structure. **[I: M-AG] [I: M-AH]**

Categorize a list of construction subsystems by its appropriate system.

Level 2 Exploration

Define by completing statements with appropriate words or write definitions of: rafter, stud, joist, modular unit, prefabrication, frostline, receptacles, conduit, circuit breaker, junction boxes, HVAC, vapor barrier. **[R: E-RB]**

Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-OI]**

Identify light, heavy, industrial and civil construction processes and techniques including site preparation.

Construct forms, as well as mix, slump test, and finish concrete for a selected project. **[I: S-YG]**

Perform the operations necessary to construct a full-size or model structure by using the tools and machines safely, accurately, and properly as demonstrated by the instructor. **[I: M-AD]**

Implement a monitoring system for the construction of a selected structure.

Level 3 Intermediate

Experiment with simulated foundations to identify their load bearing characteristics. **[I: M-AD] [I: M-AF] [I: M-AC]**

Demonstrate basic construction knowledge and skills.

Plan, design, layout and build a scale model of a model community. **[I: M-AD] [R: M-AH] [R: M-AG] [R: M-AC]**

Make sample utility (plumbing, electrical, climate control) installations on demonstrator installations.

Construction (continued)

Level 2 Introduction	Level 2 Exploration	Level 3 Intermediate
Identify four elements of the environment which are controlled by the use of insulation. **[I: SS-XS] [I: SS-GB]**		
Design and wire a doorbell circuit and a lighting circuit. **[I: M-AG] [I: M-AH] [I: S-YH]**	Wire the electrical circuits for a selected structure.	
Distinguish among heavy equipment, light equipment, portable power equipment and hand tools. **[R: E-RB]** Distinguish between scheduled and unscheduled maintenance of production equipment.	Plan and implement a maintenance schedule for construction equipment required to construct a selected structure. **[I: E-RD] [I: M-AG] [I: M-AH]**	Identify and describe the essential features of the equipment used in construction technology. **[I: E-RD] [I: E-WG]**
Match each process involved in designing a project with its definition or description. **[R: M-AG]**	Apply the problem solving process to design a selected construction project. **[R: M-AG]**	Apply the concepts of residential building design and technical drafting in producing a home design. **[I: M-AD] [R: M-AH] [R: M-AG]** Use architectural drafting procedures to produce construction-related drawings such as floor plans, elevations, foundation plans, plot plans, wall sections and details. **[R: M-AD] [R: M-AE] [R: M-AH] [R: M-AG] [R: M-AC]** Use symbols, lettering and building standards as published by the American Institute of Architects **[I: M-AD]** Incorporate safety and security measures into building designs. **[I: M-AH]** Differentiate between the elements of custom detailing and modular construction. Apply standard industrial quality control procedures to items produced in the laboratory or constructed on site. Solve materials & processing technology problems through problem solving, creative thinking and decision making processes. **[I: M-AG][I: M-AH] [I: M-AC]**

Strand #5: Materials & Processing Technology

Post-construction

Level 2 Introduction	Level 2 Exploration	Level 3 Intermediate
Match words with definitions or define: lath, furring strip, mastic, mill work, subfloor, caulking. [R: E-RB] Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. [R: E-OI]	Define by completing statements with appropriate words or write definitions of: lath, furring strip, mastic, mill work, subfloor, caulking, punch list. [R: E-RB] Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. [R: E-OI]	
Distinguish among three types of walls: load bearing, nonload bearing, and partitions. [R: E-RB] Distinguish among the aspects of finishing structures: painting, decorating, trimming, caulking, flooring, & installing equipment, fixtures & furniture. [R: E-RB] Distinguish between fixtures & furnishings. [R: E-RB] Identify at least four fixtures or accessories which are permanently installed in structures. Identify at least three purposes for exterior finishes. Prepare for and apply a finish to a structure. List types of accesses required for various construction projects.	Perform the operations necessary to construct the interior and complete the finishing processes of a full-size or model structure by using the tools and machines safely, accurately and properly as demonstrated by the instructor.	
Identify five groups of people who are concerned with inspecting construction projects. [I: SS-XS] [I: SS-XT]	Inspect a construction project using a punch list.	
List three methods of protecting a completed structure and site.	Identify key factors related to security and site maintenance in construction technology.	Apply maintenance and servicing techniques to structures.
Match maintenance tasks with the frequency of need.	Identify maintenance tasks for a selected structure as well as their frequency of need. [R: E-RD]	Apply maintenance and servicing techniques to goods and structures.

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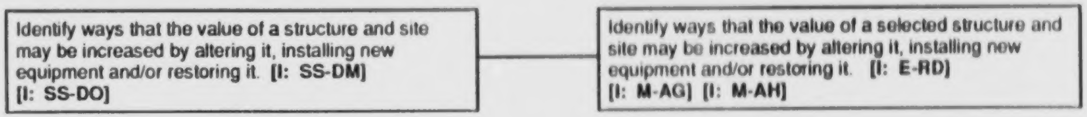
Strand #5: Materials & Processing Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Post-construction (continued)



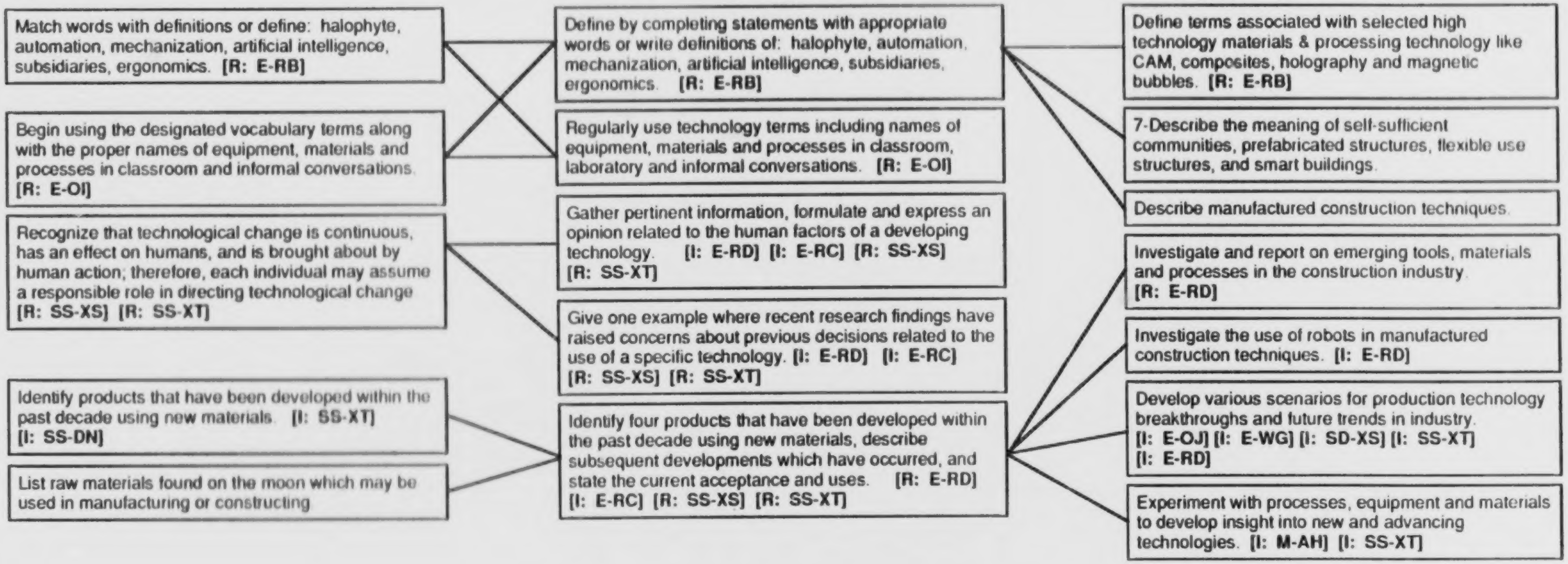
Level 2 Introduction

Identify ways that the value of a structure and site may be increased by altering it, installing new equipment and/or restoring it. [I: SS-DM] [I: SS-DO]

Level 2 Exploration

Identify ways that the value of a selected structure and site may be increased by altering it, installing new equipment and/or restoring it. [I: E-RD] [I: M-AG] [I: M-AH]

New Developments in M&P



Level 2 Introduction

Match words with definitions or define: halophyte, automation, mechanization, artificial intelligence, subsidiaries, ergonomics. [R: E-RB]

Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. [R: E-OI]

Recognize that technological change is continuous, has an effect on humans, and is brought about by human action; therefore, each individual may assume a responsible role in directing technological change. [R: SS-XS] [R: SS-XT]

Identify products that have been developed within the past decade using new materials. [I: SS-XT] [I: SS-DN]

List raw materials found on the moon which may be used in manufacturing or constructing.

Level 2 Exploration

Define by completing statements with appropriate words or write definitions of: halophyte, automation, mechanization, artificial intelligence, subsidiaries, ergonomics. [R: E-RB]

Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. [R: E-OI]

Gather pertinent information, formulate and express an opinion related to the human factors of a developing technology. [I: E-RD] [I: E-RC] [R: SS-XS] [R: SS-XT]

Give one example where recent research findings have raised concerns about previous decisions related to the use of a specific technology. [I: E-RD] [I: E-RC] [R: SS-XS] [R: SS-XT]

Identify four products that have been developed within the past decade using new materials, describe subsequent developments which have occurred, and state the current acceptance and uses. [R: E-RD] [I: E-RC] [R: SS-XS] [R: SS-XT]

Level 3 Intermediate

Define terms associated with selected high technology materials & processing technology like CAM, composites, holography and magnetic bubbles. [R: E-RB]

7-Describe the meaning of self-sufficient communities, prefabricated structures, flexible use structures, and smart buildings.

Describe manufactured construction techniques.

Investigate and report on emerging tools, materials and processes in the construction industry. [R: E-RD]

Investigate the use of robots in manufactured construction techniques. [I: E-RD]

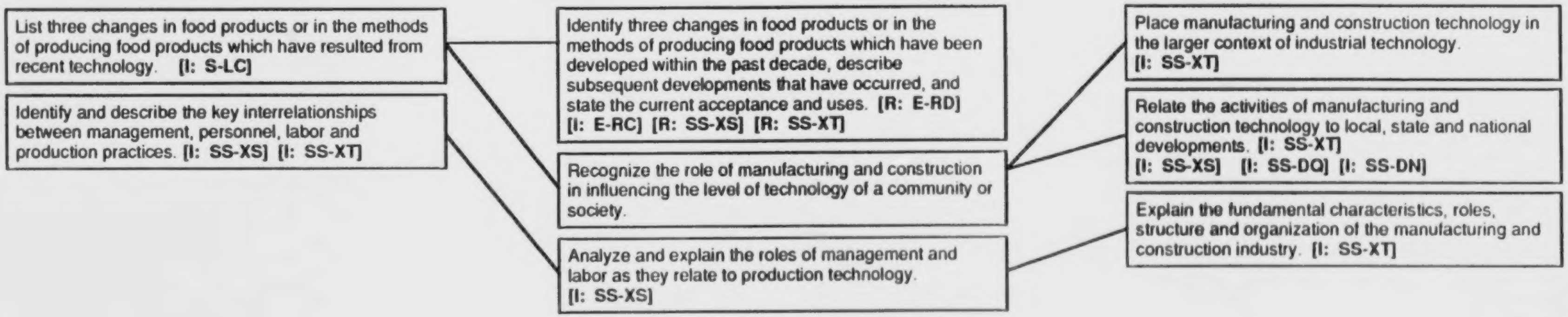
Develop various scenarios for production technology breakthroughs and future trends in industry. [I: E-OJ] [I: E-WG] [I: SD-XS] [I: SS-XT] [I: E-RD]

Experiment with processes, equipment and materials to develop insight into new and advancing technologies. [I: M-AH] [I: SS-XT]

Strand #5: Materials & Processing Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

New Developments in M&P (continued)



Level 2 Introduction

List three changes in food products or in the methods of producing food products which have resulted from recent technology. **[I: S-LC]**

Identify and describe the key interrelationships between management, personnel, labor and production practices. **[I: SS-XS] [I: SS-XT]**

Level 2 Exploration

Identify three changes in food products or in the methods of producing food products which have been developed within the past decade, describe subsequent developments that have occurred, and state the current acceptance and uses. **[R: E-RD] [I: E-RC] [R: SS-XS] [R: SS-XT]**

Recognize the role of manufacturing and construction in influencing the level of technology of a community or society.

Analyze and explain the roles of management and labor as they relate to production technology. **[I: SS-XS]**

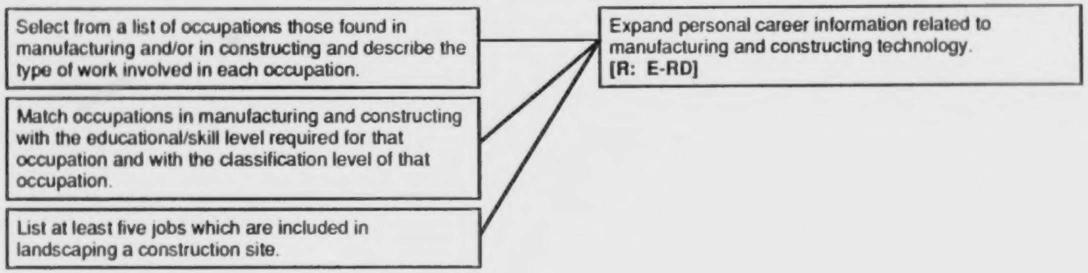
Level 3 Intermediate

Place manufacturing and construction technology in the larger context of industrial technology. **[I: SS-XT]**

Relate the activities of manufacturing and construction technology to local, state and national developments. **[I: SS-XT] [I: SS-XS] [I: SS-DQ] [I: SS-DN]**

Explain the fundamental characteristics, roles, structure and organization of the manufacturing and construction industry. **[I: SS-XT]**

Careers in M&P



Level 2 Introduction

Select from a list of occupations those found in manufacturing and/or in constructing and describe the type of work involved in each occupation.

Match occupations in manufacturing and constructing with the educational/skill level required for that occupation and with the classification level of that occupation.

List at least five jobs which are included in landscaping a construction site.

Level 2 Exploration

Expand personal career information related to manufacturing and constructing technology. **[R: E-RD]**

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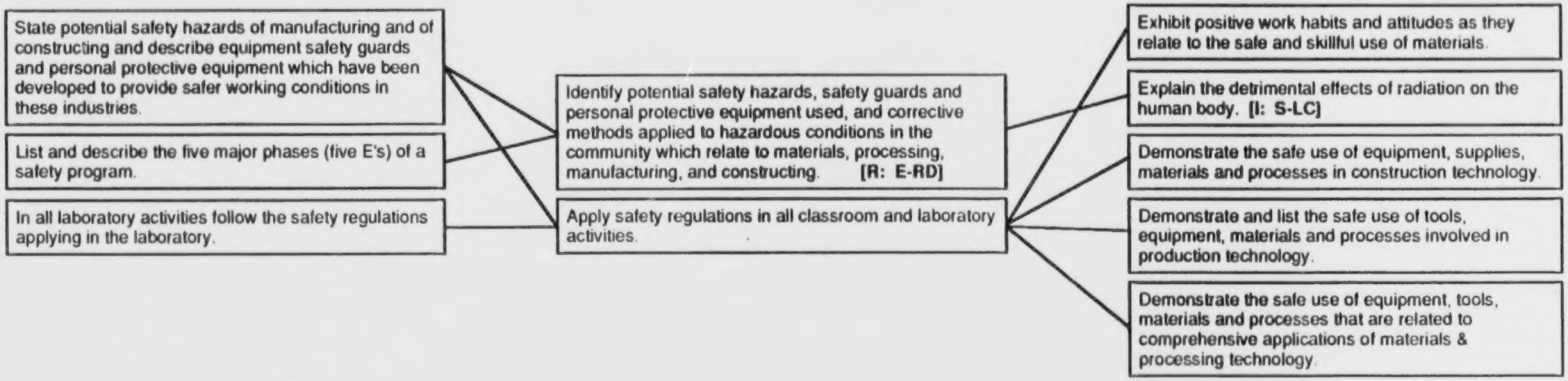
Strand #5: Materials & Processing Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

M&P Safety



State potential safety hazards of manufacturing and of constructing and describe equipment safety guards and personal protective equipment which have been developed to provide safer working conditions in these industries.

List and describe the five major phases (five E's) of a safety program.

In all laboratory activities follow the safety regulations applying in the laboratory.

Identify potential safety hazards, safety guards and personal protective equipment used, and corrective methods applied to hazardous conditions in the community which relate to materials, processing, manufacturing, and constructing. **[R: E-RD]**

Apply safety regulations in all classroom and laboratory activities.

Exhibit positive work habits and attitudes as they relate to the safe and skillful use of materials.

Explain the detrimental effects of radiation on the human body. **[I: S-LC]**

Demonstrate the safe use of equipment, supplies, materials and processes in construction technology.

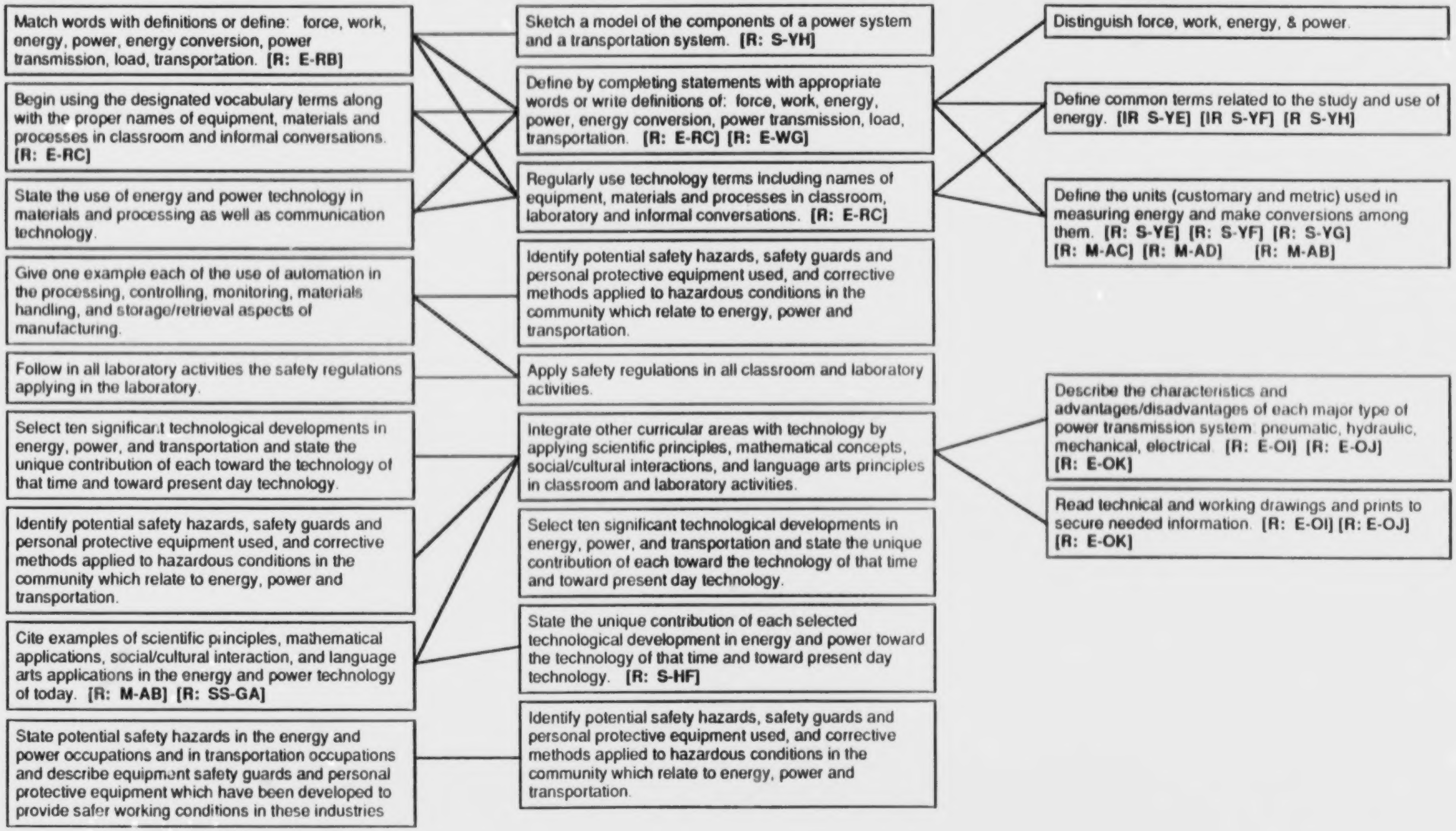
Demonstrate and list the safe use of tools, equipment, materials and processes involved in production technology.

Demonstrate the safe use of equipment, tools, materials and processes that are related to comprehensive applications of materials & processing technology.

Strand #6: Energy & Power Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Overview



Level 2 Introduction

Match words with definitions or define: force, work, energy, power, energy conversion, power transmission, load, transportation. [R: E-RB]

Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. [R: E-RC]

State the use of energy and power technology in materials and processing as well as communication technology.

Give one example each of the use of automation in the processing, controlling, monitoring, materials handling, and storage/retrieval aspects of manufacturing.

Follow in all laboratory activities the safety regulations applying in the laboratory.

Select ten significant technological developments in energy, power, and transportation and state the unique contribution of each toward the technology of that time and toward present day technology.

Identify potential safety hazards, safety guards and personal protective equipment used, and corrective methods applied to hazardous conditions in the community which relate to energy, power and transportation.

Cite examples of scientific principles, mathematical applications, social/cultural interaction, and language arts applications in the energy and power technology of today. [R: M-AB] [R: SS-GA]

State potential safety hazards in the energy and power occupations and in transportation occupations and describe equipment safety guards and personal protective equipment which have been developed to provide safer working conditions in these industries

Level 2 Exploration

Sketch a model of the components of a power system and a transportation system. [R: S-YH]

Define by completing statements with appropriate words or write definitions of: force, work, energy, power, energy conversion, power transmission, load, transportation. [R: E-RC] [R: E-WG]

Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. [R: E-RC]

Identify potential safety hazards, safety guards and personal protective equipment used, and corrective methods applied to hazardous conditions in the community which relate to energy, power and transportation.

Apply safety regulations in all classroom and laboratory activities.

Integrate other curricular areas with technology by applying scientific principles, mathematical concepts, social/cultural interactions, and language arts principles in classroom and laboratory activities.

Select ten significant technological developments in energy, power, and transportation and state the unique contribution of each toward the technology of that time and toward present day technology.

State the unique contribution of each selected technological development in energy and power toward the technology of that time and toward present day technology. [R: S-HF]

Identify potential safety hazards, safety guards and personal protective equipment used, and corrective methods applied to hazardous conditions in the community which relate to energy, power and transportation.

Level 3 Intermediate

Distinguish force, work, energy, & power.

Define common terms related to the study and use of energy. [IR S-YE] [IR S-YF] [R S-YH]

Define the units (customary and metric) used in measuring energy and make conversions among them. [R: S-YE] [R: S-YF] [R: S-YG] [R: M-AC] [R: M-AD] [R: M-AB]

Describe the characteristics and advantages/disadvantages of each major type of power transmission system: pneumatic, hydraulic, mechanical, electrical. [R: E-OI] [R: E-OJ] [R: E-OK]

Read technical and working drawings and prints to secure needed information. [R: E-OI] [R: E-OJ] [R: E-OK]

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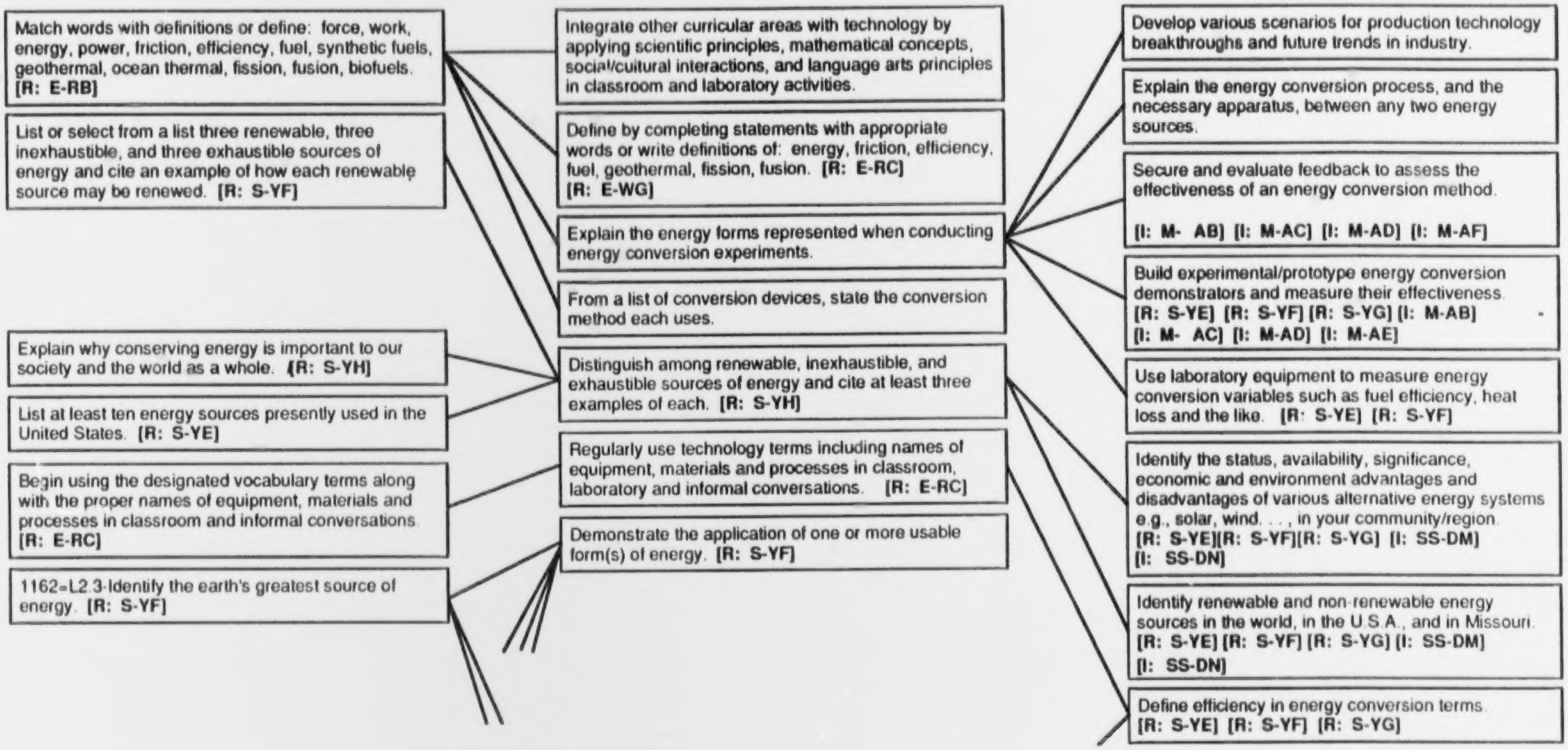
Strand #6: Energy & Power Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

E&P Conversions



Level 2 Introduction

- Match words with definitions or define: force, work, energy, power, friction, efficiency, fuel, synthetic fuels, geothermal, ocean thermal, fission, fusion, biofuels. [R: E-RB]
- List or select from a list three renewable, three inexhaustible, and three exhaustible sources of energy and cite an example of how each renewable source may be renewed. [R: S-YF]
- Explain why conserving energy is important to our society and the world as a whole. [R: S-YH]
- List at least ten energy sources presently used in the United States. [R: S-YE]
- Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. [R: E-RC]
- 1162=L2.3-Identify the earth's greatest source of energy. [R: S-YF]

Level 2 Exploration

- Integrate other curricular areas with technology by applying scientific principles, mathematical concepts, social/cultural interactions, and language arts principles in classroom and laboratory activities.
- Define by completing statements with appropriate words or write definitions of: energy, friction, efficiency, fuel, geothermal, fission, fusion. [R: E-RC] [R: E-WG]
- Explain the energy forms represented when conducting energy conversion experiments.
- From a list of conversion devices, state the conversion method each uses.
- Distinguish among renewable, inexhaustible, and exhaustible sources of energy and cite at least three examples of each. [R: S-YH]
- Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. [R: E-RC]
- Demonstrate the application of one or more usable form(s) of energy. [R: S-YF]

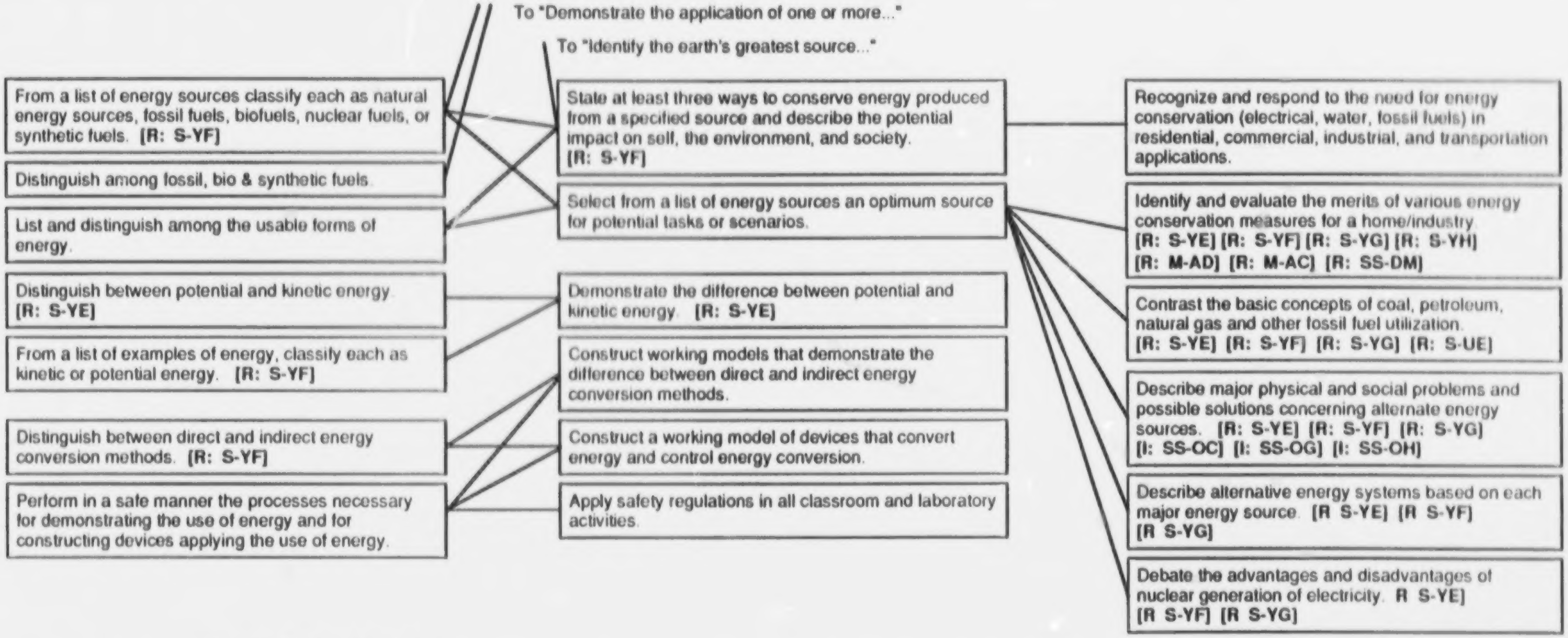
Level 3 Intermediate

- Develop various scenarios for production technology breakthroughs and future trends in industry.
- Explain the energy conversion process, and the necessary apparatus, between any two energy sources.
- Secure and evaluate feedback to assess the effectiveness of an energy conversion method. [I: M- AB] [I: M-AC] [I: M-AD] [I: M-AF]
- Build experimental/prototype energy conversion demonstrators and measure their effectiveness. [R: S-YE] [R: S-YF] [R: S-YG] [I: M-AB] [I: M- AC] [I: M-AD] [I: M-AE]
- Use laboratory equipment to measure energy conversion variables such as fuel efficiency, heat loss and the like. [R: S-YE] [R: S-YF]
- Identify the status, availability, significance, economic and environment advantages and disadvantages of various alternative energy systems e.g., solar, wind. . . , in your community/region. [R: S-YE][R: S-YF][R: S-YG] [I: SS-DM] [I: SS-DN]
- Identify renewable and non-renewable energy sources in the world, in the U.S.A., and in Missouri. [R: S-YE] [R: S-YF] [R: S-YG] [I: SS-DM] [I: SS-DN]
- Define efficiency in energy conversion terms. [R: S-YE] [R: S-YF] [R: S-YG]

Strand #6: Energy & Power Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

E&P Conversions (continued)



To "Demonstrate the application of one or more..."

To "Identify the earth's greatest source..."

Level 2 Introduction

- From a list of energy sources classify each as natural energy sources, fossil fuels, biofuels, nuclear fuels, or synthetic fuels. **[R: S-YF]**
- Distinguish among fossil, bio & synthetic fuels.
- List and distinguish among the usable forms of energy.
- Distinguish between potential and kinetic energy. **[R: S-YE]**
- From a list of examples of energy, classify each as kinetic or potential energy. **[R: S-YF]**
- Distinguish between direct and indirect energy conversion methods. **[R: S-YF]**
- Perform in a safe manner the processes necessary for demonstrating the use of energy and for constructing devices applying the use of energy.

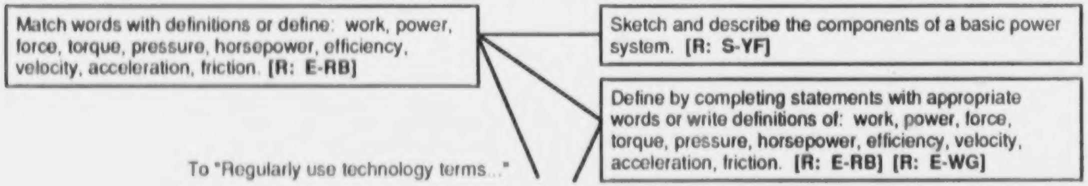
Level 2 Exploration

- State at least three ways to conserve energy produced from a specified source and describe the potential impact on self, the environment, and society. **[R: S-YF]**
- Select from a list of energy sources an optimum source for potential tasks or scenarios.
- Demonstrate the difference between potential and kinetic energy. **[R: S-YE]**
- Construct working models that demonstrate the difference between direct and indirect energy conversion methods.
- Construct a working model of devices that convert energy and control energy conversion.
- Apply safety regulations in all classroom and laboratory activities.

Level 3 Intermediate

- Recognize and respond to the need for energy conservation (electrical, water, fossil fuels) in residential, commercial, industrial, and transportation applications.
- Identify and evaluate the merits of various energy conservation measures for a home/industry. **[R: S-YE] [R: S-YF] [R: S-YG] [R: S-YH] [R: M-AD] [R: M-AC] [R: SS-DM]**
- Contrast the basic concepts of coal, petroleum, natural gas and other fossil fuel utilization. **[R: S-YE] [R: S-YF] [R: S-YG] [R: S-UE]**
- Describe major physical and social problems and possible solutions concerning alternate energy sources. **[R: S-YE] [R: S-YF] [R: S-YG] [I: SS-OC] [I: SS-OG] [I: SS-OH]**
- Describe alternative energy systems based on each major energy source. **[R S-YE] [R S-YF] [R S-YG]**
- Debate the advantages and disadvantages of nuclear generation of electricity. **R S-YE] [R S-YF] [R S-YG]**

Power Transmission



Level 2 Introduction

- Match words with definitions or define: work, power, force, torque, pressure, horsepower, efficiency, velocity, acceleration, friction. **[R: E-RB]**

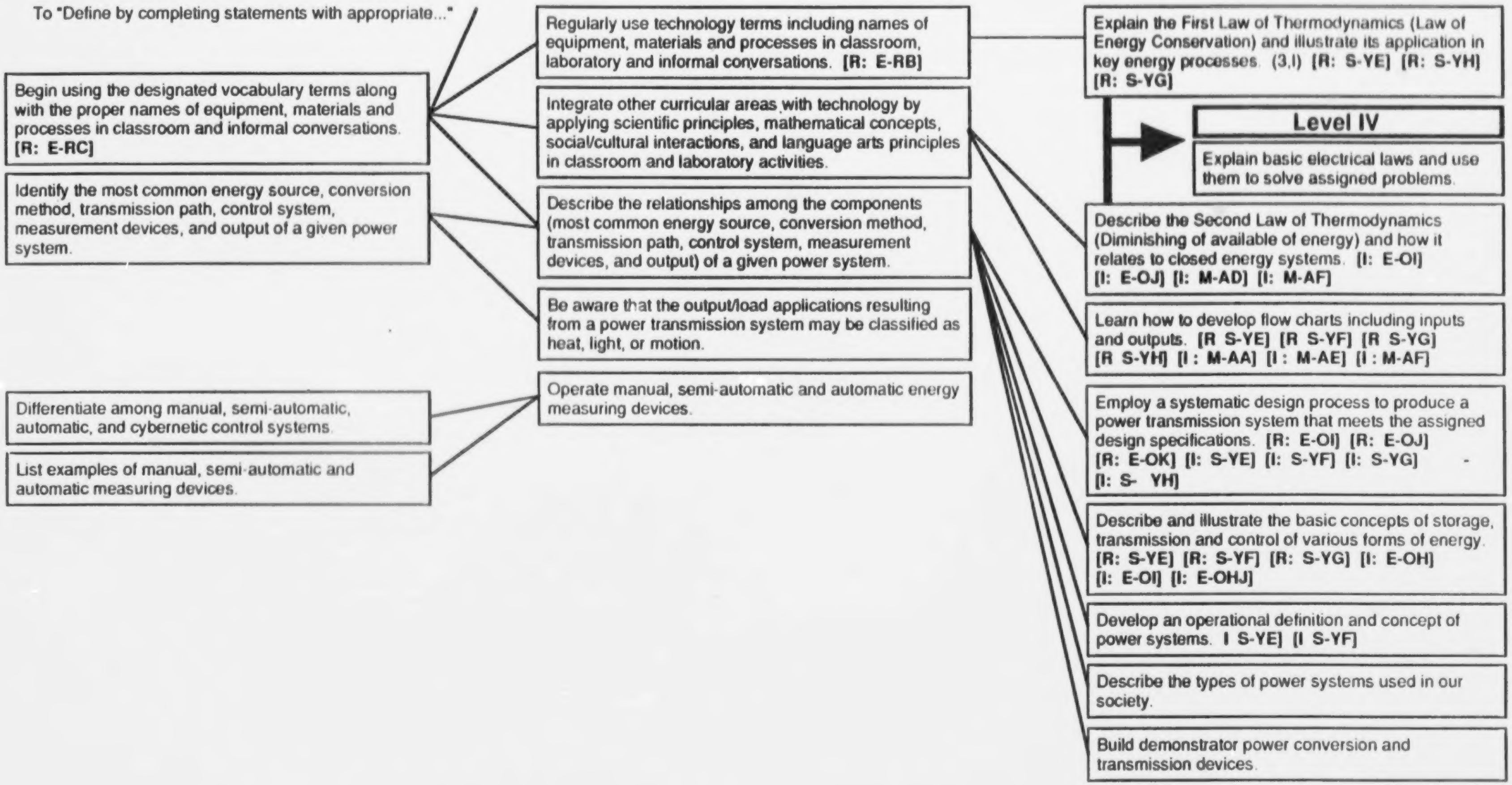
To "Regularly use technology terms..."

Level 2 Exploration

- Sketch and describe the components of a basic power system. **[R: S-YF]**
- Define by completing statements with appropriate words or write definitions of: work, power, force, torque, pressure, horsepower, efficiency, velocity, acceleration, friction. **[R: E-RB] [R: E-WG]**

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Power Transmission (continued)



Level 2 Introduction

To "Define by completing statements with appropriate..."

Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. [R: E-RC]

Identify the most common energy source, conversion method, transmission path, control system, measurement devices, and output of a given power system.

Differentiate among manual, semi-automatic, automatic, and cybernetic control systems.

List examples of manual, semi-automatic and automatic measuring devices.

Level 2 Exploration

Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. [R: E-RB]

Integrate other curricular areas with technology by applying scientific principles, mathematical concepts, social/cultural interactions, and language arts principles in classroom and laboratory activities.

Describe the relationships among the components (most common energy source, conversion method, transmission path, control system, measurement devices, and output) of a given power system.

Be aware that the output/load applications resulting from a power transmission system may be classified as heat, light, or motion.

Operate manual, semi-automatic and automatic energy measuring devices.

Level 3 Intermediate

Explain the First Law of Thermodynamics (Law of Energy Conservation) and illustrate its application in key energy processes. (3,I) [R: S-YE] [R: S-YH] [R: S-YG]

Level IV

Explain basic electrical laws and use them to solve assigned problems.

Describe the Second Law of Thermodynamics (Diminishing of available of energy) and how it relates to closed energy systems. [I: E-OI] [I: E-OJ] [I: M-AD] [I: M-AF]

Learn how to develop flow charts including inputs and outputs. [R S-YE] [R S-YF] [R S-YG] [R S-YH] [I : M-AA] [I : M-AE] [I : M-AF]

Employ a systematic design process to produce a power transmission system that meets the assigned design specifications. [R: E-OI] [R: E-OJ] [R: E-OK] [I: S-YE] [I: S-YF] [I: S-YG] [I: S- YH]

Describe and illustrate the basic concepts of storage, transmission and control of various forms of energy. [R: S-YE] [R: S-YF] [R: S-YG] [I: E-OH] [I: E-OI] [I: E-OHJ]

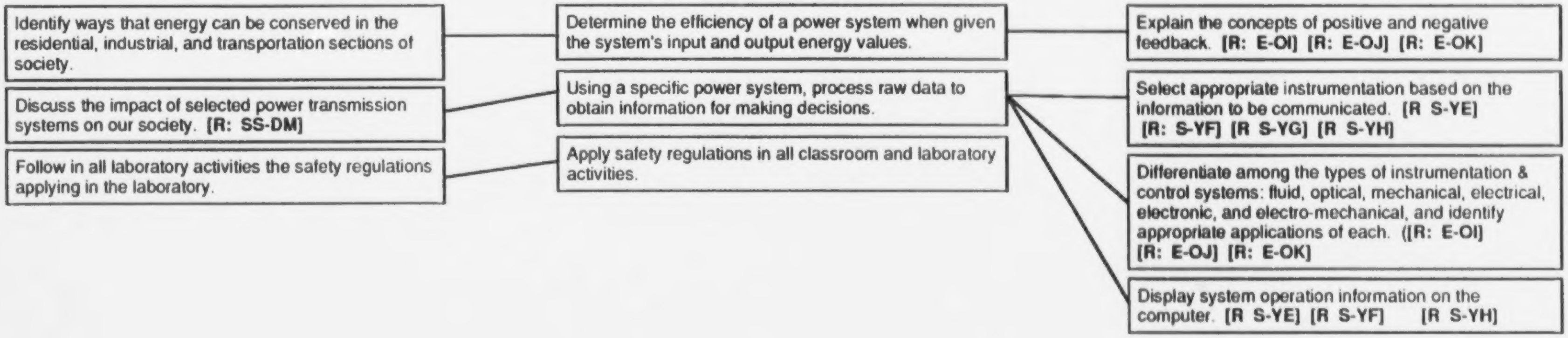
Develop an operational definition and concept of power systems. I S-YE] [I S-YF]

Describe the types of power systems used in our society.

Build demonstrator power conversion and transmission devices.

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Power Transmission (continued)



Level 2 Introduction

Identify ways that energy can be conserved in the residential, industrial, and transportation sections of society.

Discuss the impact of selected power transmission systems on our society. **[R: SS-DM]**

Follow in all laboratory activities the safety regulations applying in the laboratory.

Level 2 Exploration

Determine the efficiency of a power system when given the system's input and output energy values.

Using a specific power system, process raw data to obtain information for making decisions.

Apply safety regulations in all classroom and laboratory activities.

Level 3 Intermediate

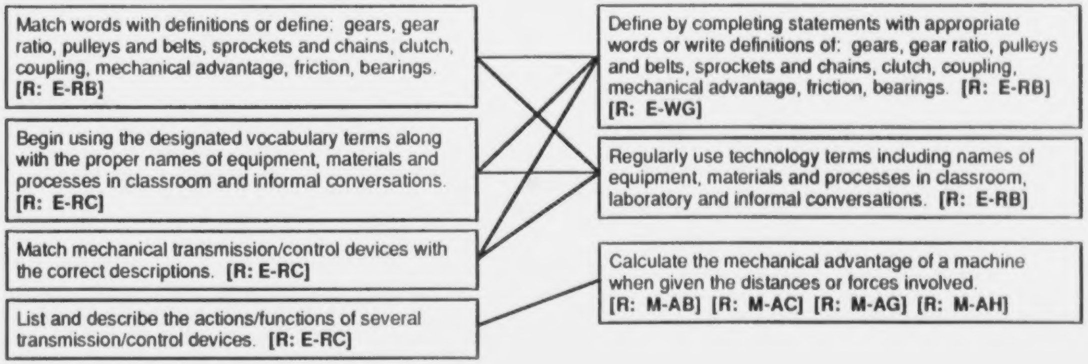
Explain the concepts of positive and negative feedback. **[R: E-OI] [R: E-OJ] [R: E-OK]**

Select appropriate instrumentation based on the information to be communicated. **[R S-YE] [R: S-YF] [R S-YG] [R S-YH]**

Differentiate among the types of instrumentation & control systems: fluid, optical, mechanical, electrical, electronic, and electro-mechanical, and identify appropriate applications of each. **([R: E-OI] [R: E-OJ] [R: E-OK]**

Display system operation information on the computer. **[R S-YE] [R S-YF] [R S-YH]**

Mechanical Power Transmission



Level 2 Introduction

Match words with definitions or define: gears, gear ratio, pulleys and belts, sprockets and chains, clutch, coupling, mechanical advantage, friction, bearings. **[R: E-RB]**

Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-RC]**

Match mechanical transmission/control devices with the correct descriptions. **[R: E-RC]**

List and describe the actions/functions of several transmission/control devices. **[R: E-RC]**

Level 2 Exploration

Define by completing statements with appropriate words or write definitions of: gears, gear ratio, pulleys and belts, sprockets and chains, clutch, coupling, mechanical advantage, friction, bearings. **[R: E-RB] [R: E-WG]**

Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-RB]**

Calculate the mechanical advantage of a machine when given the distances or forces involved. **[R: M-AB] [R: M-AC] [R: M-AG] [R: M-AH]**

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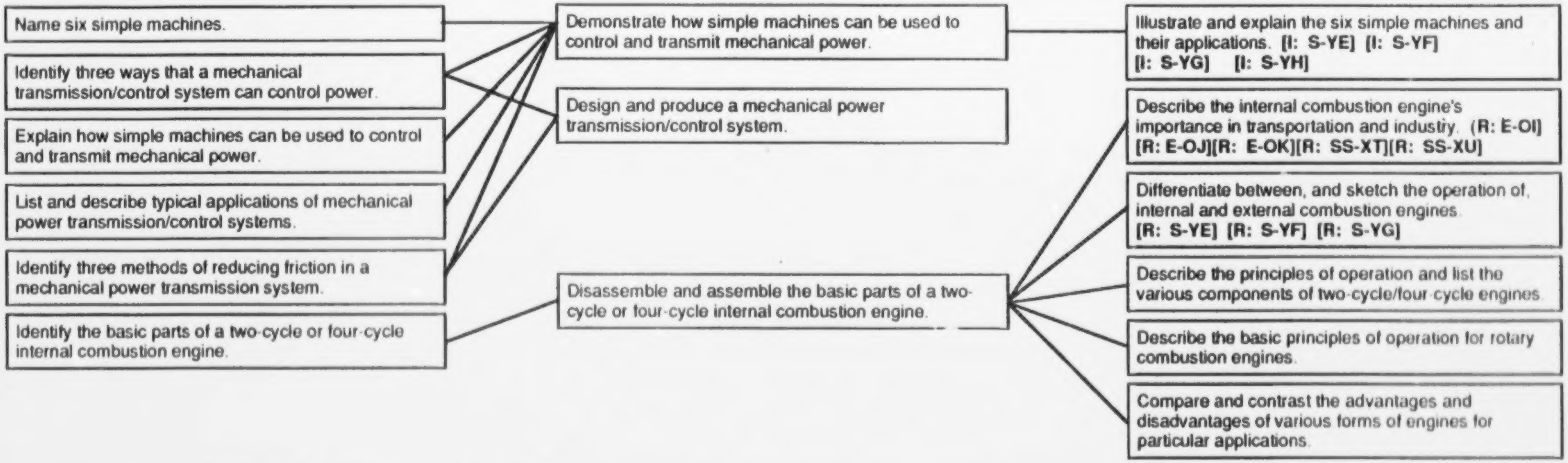
Mechanical Power Transmission (continued)



Level 2 Introduction

- Name six simple machines.
- Identify three ways that a mechanical transmission/control system can control power.
- Explain how simple machines can be used to control and transmit mechanical power.
- List and describe typical applications of mechanical power transmission/control systems.
- Identify three methods of reducing friction in a mechanical power transmission system.
- Identify the basic parts of a two-cycle or four-cycle internal combustion engine.

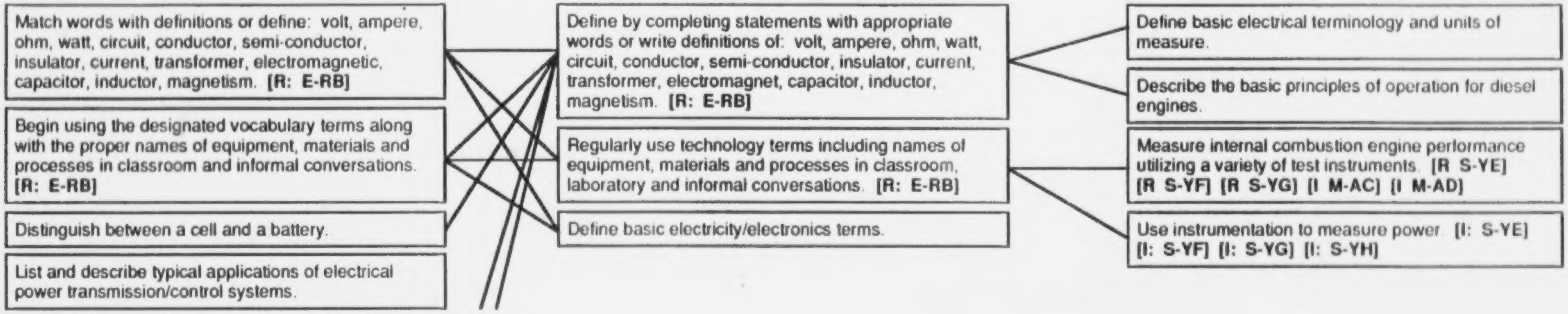
Level 2 Exploration

- Demonstrate how simple machines can be used to control and transmit mechanical power.
- Design and produce a mechanical power transmission/control system.
- Disassemble and assemble the basic parts of a two-cycle or four-cycle internal combustion engine.

Level 3 Intermediate

- Illustrate and explain the six simple machines and their applications. **[I: S-YE] [I: S-YF] [I: S-YG] [I: S-YH]**
- Describe the internal combustion engine's importance in transportation and industry. **(R: E-OI] [R: E-OJ][R: E-OK][R: SS-XT][R: SS-XU]**
- Differentiate between, and sketch the operation of, internal and external combustion engines. **[R: S-YE] [R: S-YF] [R: S-YG]**
- Describe the principles of operation and list the various components of two-cycle/four-cycle engines.
- Describe the basic principles of operation for rotary combustion engines.
- Compare and contrast the advantages and disadvantages of various forms of engines for particular applications.

Electrical Power Transmission



Level 2 Introduction

- Match words with definitions or define: volt, ampere, ohm, watt, circuit, conductor, semi-conductor, insulator, current, transformer, electromagnetic, capacitor, inductor, magnetism. **[R: E-RB]**
- Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-RB]**
- Distinguish between a cell and a battery.
- List and describe typical applications of electrical power transmission/control systems.

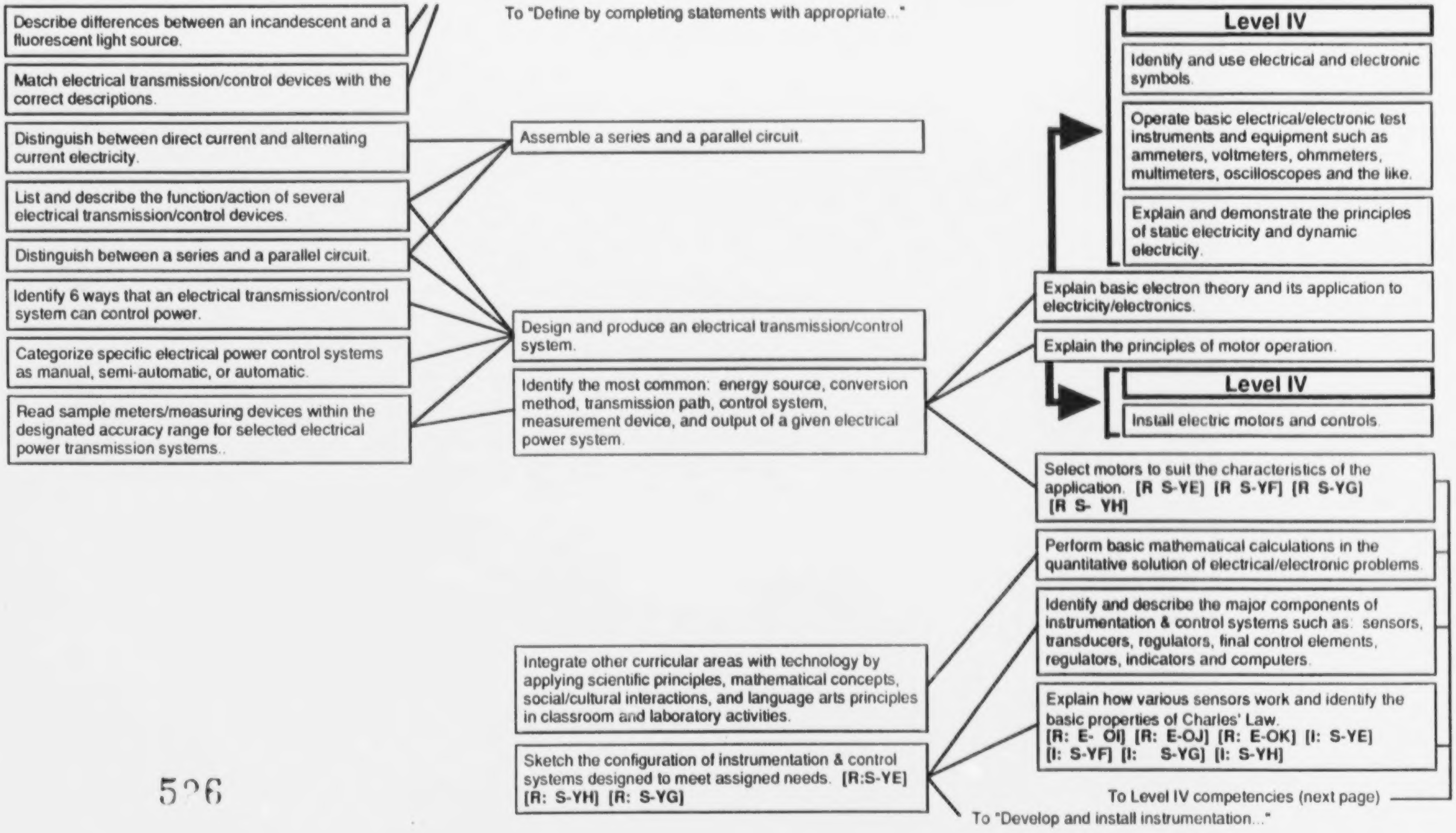
Level 2 Exploration

- Define by completing statements with appropriate words or write definitions of: volt, ampere, ohm, watt, circuit, conductor, semi-conductor, insulator, current, transformer, electromagnet, capacitor, inductor, magnetism. **[R: E-RB]**
- Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-RB]**
- Define basic electricity/electronics terms.

Level 3 Intermediate

- Define basic electrical terminology and units of measure.
- Describe the basic principles of operation for diesel engines.
- Measure internal combustion engine performance utilizing a variety of test instruments. **[R S-YE] [R S-YF] [R S-YG] [I M-AC] [I M-AD]**
- Use instrumentation to measure power. **[I: S-YE] [I: S-YF] [I: S-YG] [I: S-YH]**

Electrical Power Transmission (continued)



Describe differences between an incandescent and a fluorescent light source.

Match electrical transmission/control devices with the correct descriptions.

Distinguish between direct current and alternating current electricity.

List and describe the function/action of several electrical transmission/control devices.

Distinguish between a series and a parallel circuit.

Identify 6 ways that an electrical transmission/control system can control power.

Categorize specific electrical power control systems as manual, semi-automatic, or automatic.

Read sample meters/measuring devices within the designated accuracy range for selected electrical power transmission systems..

To "Define by completing statements with appropriate..."

Assemble a series and a parallel circuit.

Design and produce an electrical transmission/control system.

Identify the most common: energy source, conversion method, transmission path, control system, measurement device, and output of a given electrical power system.

Integrate other curricular areas with technology by applying scientific principles, mathematical concepts, social/cultural interactions, and language arts principles in classroom and laboratory activities.

Sketch the configuration of instrumentation & control systems designed to meet assigned needs. [R:S-YE] [R: S-YH] [R: S-YG]

Level IV

Identify and use electrical and electronic symbols.

Operate basic electrical/electronic test instruments and equipment such as ammeters, voltmeters, ohmmeters, multimeters, oscilloscopes and the like.

Explain and demonstrate the principles of static electricity and dynamic electricity.

Explain basic electron theory and its application to electricity/electronics.

Explain the principles of motor operation.

Level IV

Install electric motors and controls.

Select motors to suit the characteristics of the application. [R S-YE] [R S-YF] [R S-YG] [R S- YH]

Perform basic mathematical calculations in the quantitative solution of electrical/electronic problems.

Identify and describe the major components of instrumentation & control systems such as: sensors, transducers, regulators, final control elements, regulators, indicators and computers.

Explain how various sensors work and identify the basic properties of Charles' Law. [R: E- OI] [R: E-OJ] [R: E-OK] [I: S-YE] [I: S-YF] [I: S-YG] [I: S-YH]

To Level IV competencies (next page)

To "Develop and install instrumentation..."

Electrical Power Transmission (continued)

- Develop and install instrumentation & control systems on laboratory energy & power systems.
- Identify and describe the major electrical and electronic components used in conventional applications.

Level IV

- Connect series, parallel and series-parallel circuits.
- Describe the principles of magnetism and electromagnetism.
- Differentiate between alternating and direct current and demonstrate the differences.
- Draw and read basic electrical schematic diagrams.
- Describe the basic concept of solid state circuitry.
- Interpret logic diagrams.
- Differentiate between digital and analog circuits and components.
- Explain the construction and use of integrated circuits.
- Use electronic components to build temporary and/or permanent circuits.
- Assemble basic audio amplifiers and describe their operation and purposes.

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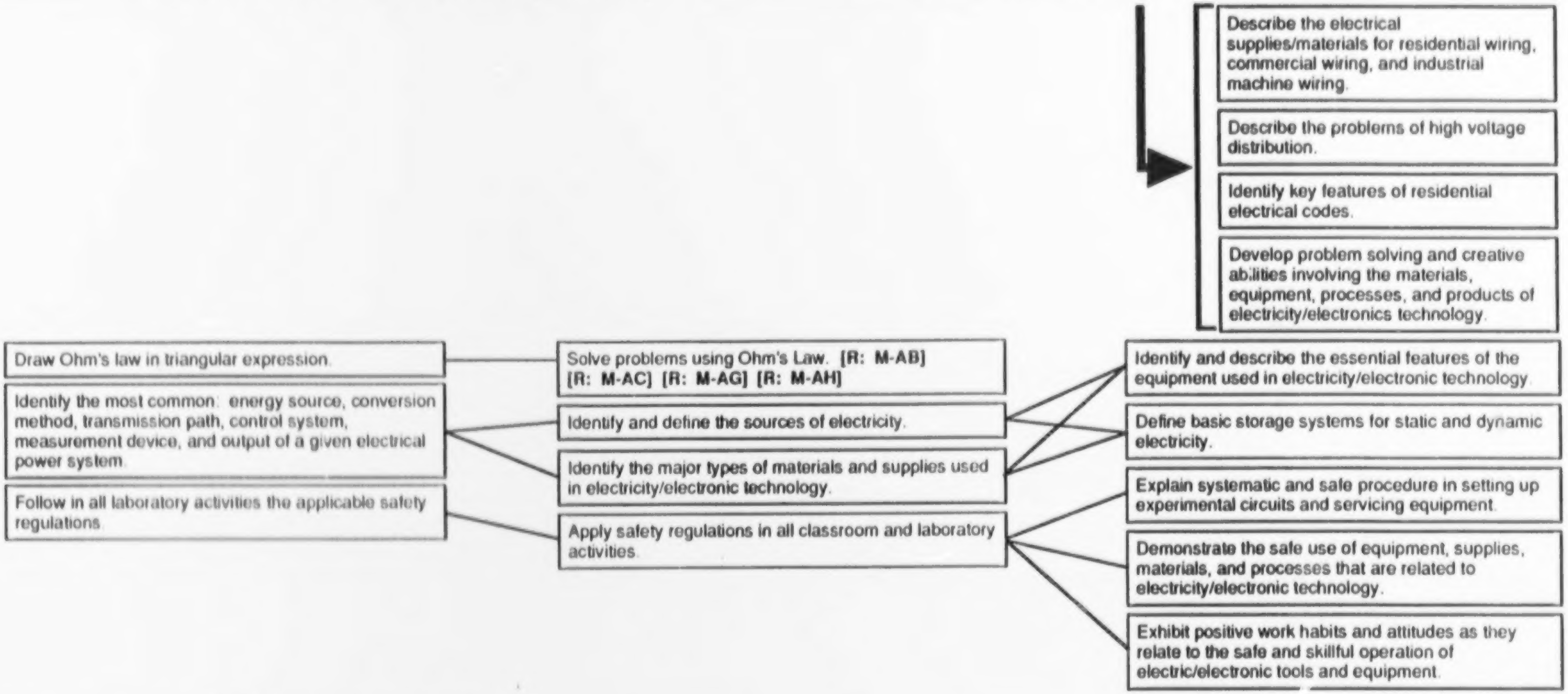
Electrical Power Transmission (continued)



Draw Ohm's law in triangular expression.

Identify the most common: energy source, conversion method, transmission path, control system, measurement device, and output of a given electrical power system.

Follow in all laboratory activities the applicable safety regulations.

Solve problems using Ohm's Law. **[R: M-AB] [R: M-AC] [R: M-AG] [R: M-AH]**

Identify and define the sources of electricity.

Identify the major types of materials and supplies used in electricity/electronic technology.

Apply safety regulations in all classroom and laboratory activities.

Describe the electrical supplies/materials for residential wiring, commercial wiring, and industrial machine wiring.

Describe the problems of high voltage distribution.

Identify key features of residential electrical codes.

Develop problem solving and creative abilities involving the materials, equipment, processes, and products of electricity/electronics technology.

Identify and describe the essential features of the equipment used in electricity/electronic technology.

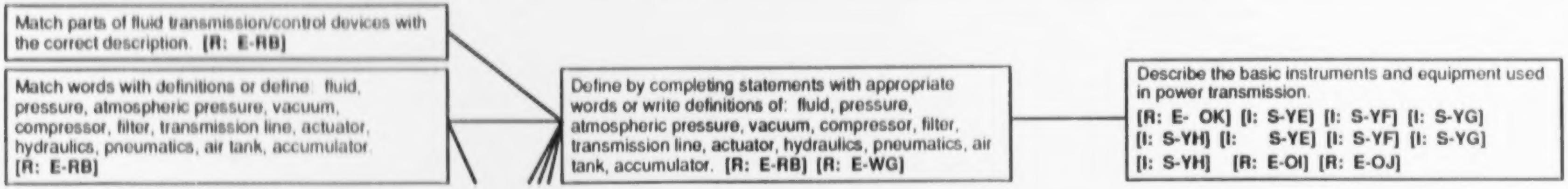
Define basic storage systems for static and dynamic electricity.

Explain systematic and safe procedure in setting up experimental circuits and servicing equipment.

Demonstrate the safe use of equipment, supplies, materials, and processes that are related to electricity/electronic technology.

Exhibit positive work habits and attitudes as they relate to the safe and skillful operation of electric/electronic tools and equipment.

Fluid Power Transmission



Match parts of fluid transmission/control devices with the correct description. **[R: E-RB]**

Match words with definitions or define: fluid, pressure, atmospheric pressure, vacuum, compressor, filter, transmission line, actuator, hydraulics, pneumatics, air tank, accumulator. **[R: E-RB]**

Define by completing statements with appropriate words or write definitions of: fluid, pressure, atmospheric pressure, vacuum, compressor, filter, transmission line, actuator, hydraulics, pneumatics, air tank, accumulator. **[R: E-RB] [R: E-WG]**

Describe the basic instruments and equipment used in power transmission.
[R: E- OK] [I: S-YE] [I: S-YF] [I: S-YG] [I: S-YH] [I: S-YE] [I: S-YF] [I: S-YG] [I: S-YH] [R: E-OI] [R: E-OJ]

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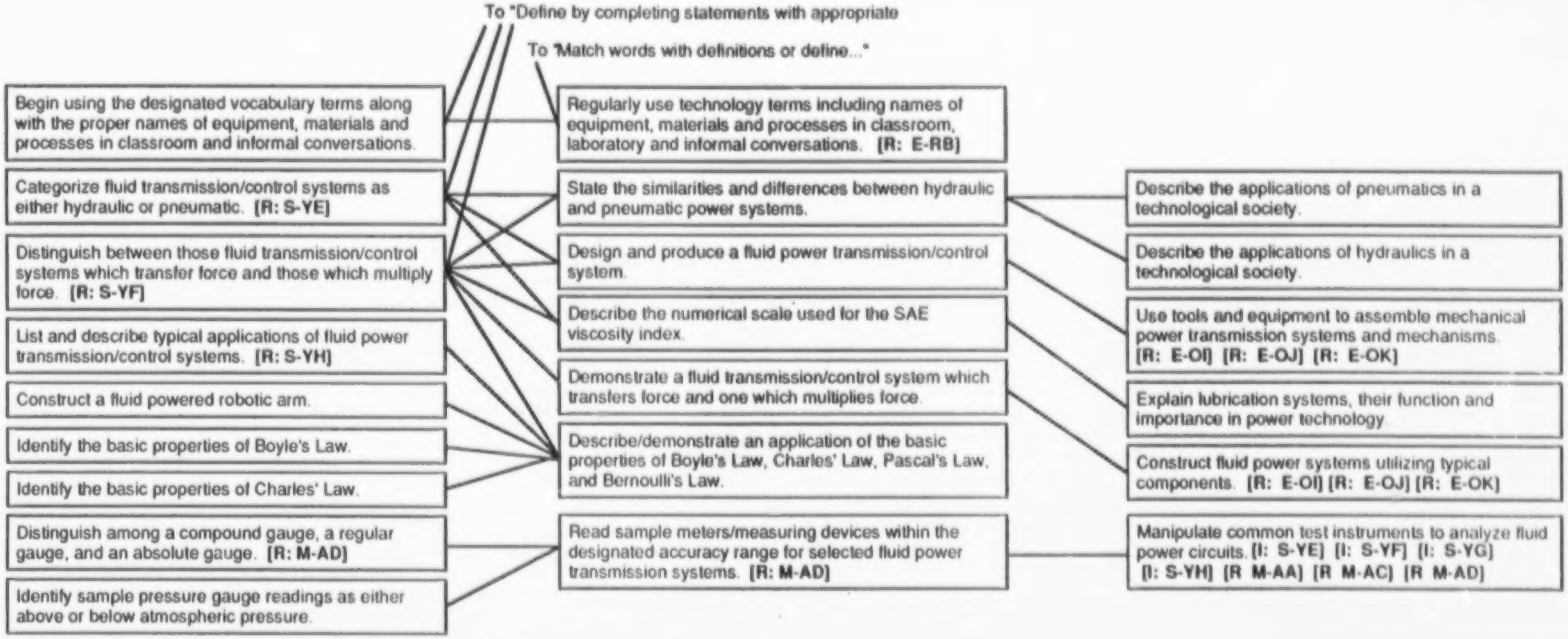
Fluid Power Transmission (continued)



To "Define by completing statements with appropriate

To "Match words with definitions or define..."

Level 2 Introduction

- Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations.
- Categorize fluid transmission/control systems as either hydraulic or pneumatic. **[R: S-YE]**
- Distinguish between those fluid transmission/control systems which transfer force and those which multiply force. **[R: S-YF]**
- List and describe typical applications of fluid power transmission/control systems. **[R: S-YH]**
- Construct a fluid powered robotic arm.
- Identify the basic properties of Boyle's Law.
- Identify the basic properties of Charles' Law.
- Distinguish among a compound gauge, a regular gauge, and an absolute gauge. **[R: M-AD]**
- Identify sample pressure gauge readings as either above or below atmospheric pressure.

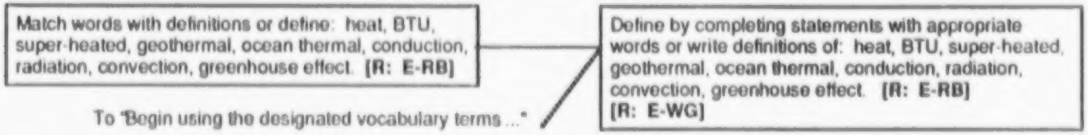
Level 2 Exploration

- Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-RB]**
- State the similarities and differences between hydraulic and pneumatic power systems.
- Design and produce a fluid power transmission/control system.
- Describe the numerical scale used for the SAE viscosity index.
- Demonstrate a fluid transmission/control system which transfers force and one which multiplies force.
- Describe/demonstrate an application of the basic properties of Boyle's Law, Charles' Law, Pascal's Law, and Bernoulli's Law.
- Read sample meters/measuring devices within the designated accuracy range for selected fluid power transmission systems. **[R: M-AD]**

Level 3 Intermediate

- Describe the applications of pneumatics in a technological society.
- Describe the applications of hydraulics in a technological society.
- Use tools and equipment to assemble mechanical power transmission systems and mechanisms. **[R: E-OI] [R: E-OJ] [R: E-OK]**
- Explain lubrication systems, their function and importance in power technology.
- Construct fluid power systems utilizing typical components. **[R: E-OI] [R: E-OJ] [R: E-OK]**
- Manipulate common test instruments to analyze fluid power circuits. **[I: S-YE] [I: S-YF] [I: S-YG] [I: S-YH] [R M-AA] [R M-AC] [R M-AD]**

Thermal Power Transmission



- Match words with definitions or define: heat, BTU, super-heated, geothermal, ocean thermal, conduction, radiation, convection, greenhouse effect. **[R: E-RB]**
- Define by completing statements with appropriate words or write definitions of: heat, BTU, super-heated, geothermal, ocean thermal, conduction, radiation, convection, greenhouse effect. **[R: E-RB] [R: E-WG]**

To "Begin using the designated vocabulary terms ..."

Strand #6: Energy & Power Technology

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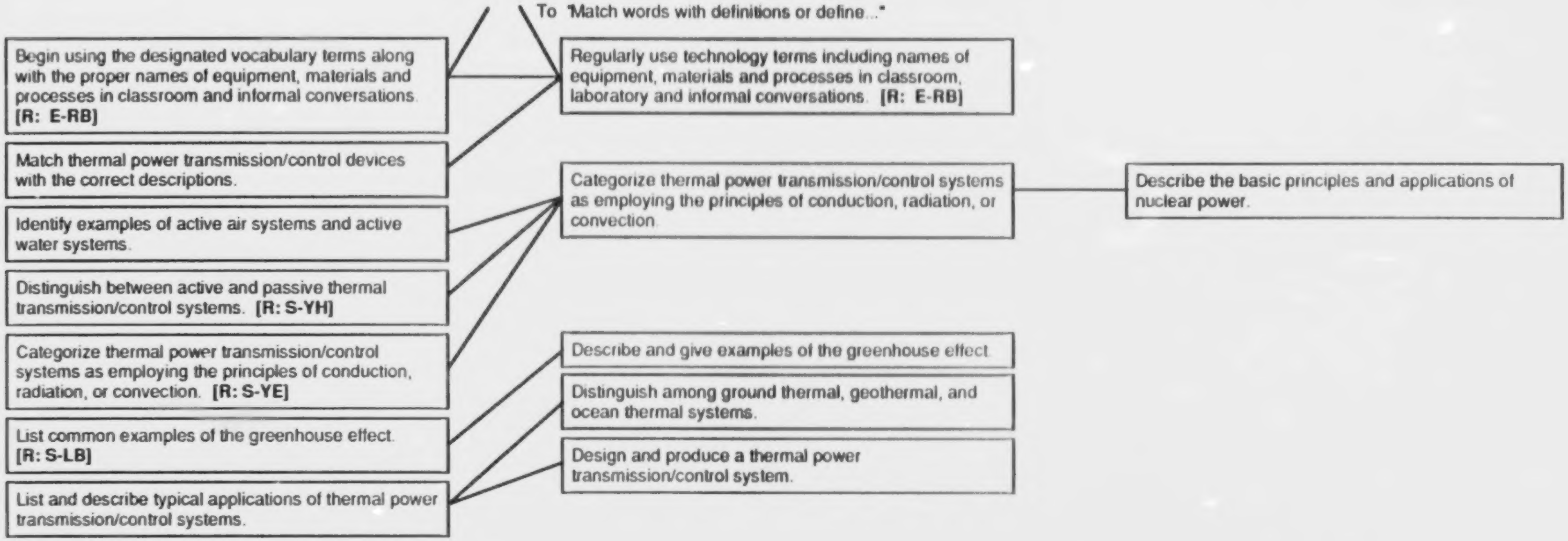
Thermal Power Transmission (continued)



Level 2 Introduction

- Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-RB]**
- Match thermal power transmission/control devices with the correct descriptions.
- Identify examples of active air systems and active water systems.
- Distinguish between active and passive thermal transmission/control systems. **[R: S-YH]**
- Categorize thermal power transmission/control systems as employing the principles of conduction, radiation, or convection. **[R: S-YE]**
- List common examples of the greenhouse effect. **[R: S-LB]**
- List and describe typical applications of thermal power transmission/control systems.

Level 2 Exploration

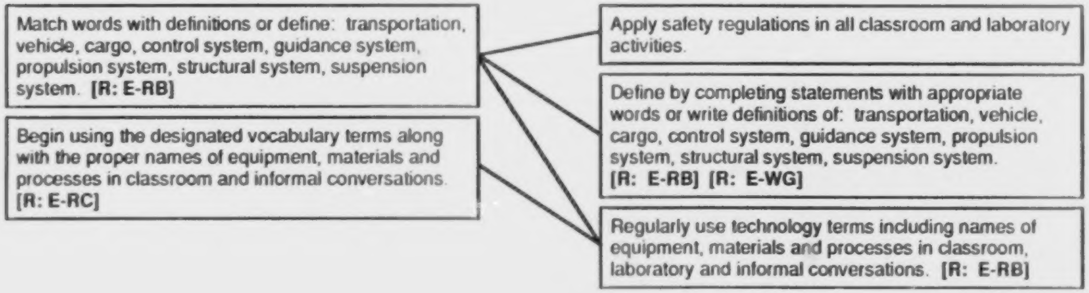
To "Match words with definitions or define..."

- Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-RB]**
- Categorize thermal power transmission/control systems as employing the principles of conduction, radiation, or convection.
- Describe and give examples of the greenhouse effect.
- Distinguish among ground thermal, geothermal, and ocean thermal systems.
- Design and produce a thermal power transmission/control system.

Level 3 Intermediate

- Describe the basic principles and applications of nuclear power.

Introduction to Transportation



Level 2 Introduction

- Match words with definitions or define: transportation, vehicle, cargo, control system, guidance system, propulsion system, structural system, suspension system. **[R: E-RB]**
- Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-RC]**

Level 2 Exploration

- Apply safety regulations in all classroom and laboratory activities.
- Define by completing statements with appropriate words or write definitions of: transportation, vehicle, cargo, control system, guidance system, propulsion system, structural system, suspension system. **[R: E-RB] [R: E-WG]**
- Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-RB]**

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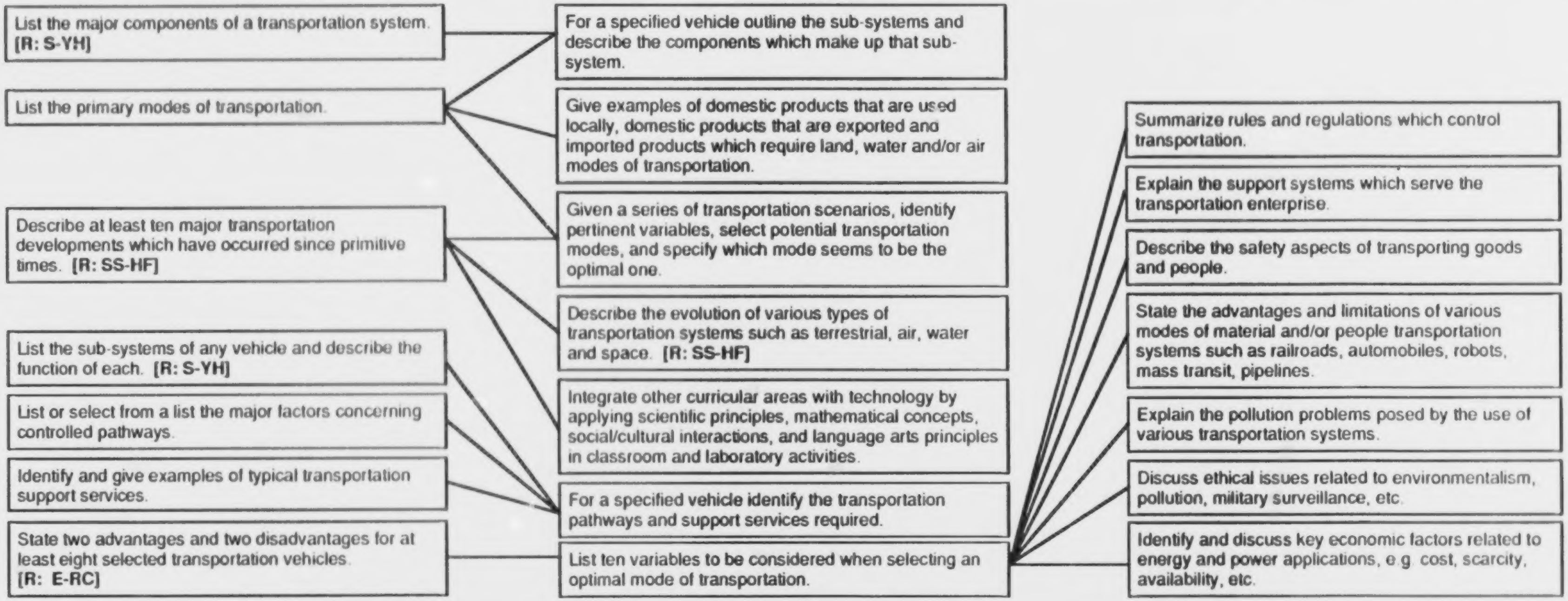
Introduction to Transportation (continued)



Level 2 Introduction

- List the major components of a transportation system. **[R: S-YH]**
- List the primary modes of transportation.
- Describe at least ten major transportation developments which have occurred since primitive times. **[R: SS-HF]**
- List the sub-systems of any vehicle and describe the function of each. **[R: S-YH]**
- List or select from a list the major factors concerning controlled pathways.
- Identify and give examples of typical transportation support services.
- State two advantages and two disadvantages for at least eight selected transportation vehicles. **[R: E-RC]**

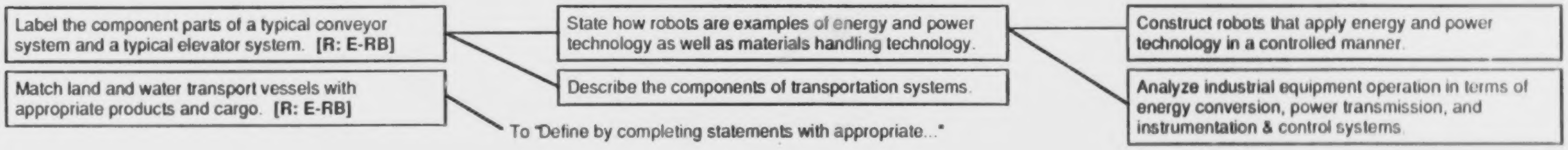
Level 2 Exploration

- For a specified vehicle outline the sub-systems and describe the components which make up that sub-system.
- Give examples of domestic products that are used locally, domestic products that are exported and imported products which require land, water and/or air modes of transportation.
- Given a series of transportation scenarios, identify pertinent variables, select potential transportation modes, and specify which mode seems to be the optimal one.
- Describe the evolution of various types of transportation systems such as terrestrial, air, water and space. **[R: SS-HF]**
- Integrate other curricular areas with technology by applying scientific principles, mathematical concepts, social/cultural interactions, and language arts principles in classroom and laboratory activities.
- For a specified vehicle identify the transportation pathways and support services required.
- List ten variables to be considered when selecting an optimal mode of transportation.

Level 3 Intermediate

- Summarize rules and regulations which control transportation.
- Explain the support systems which serve the transportation enterprise.
- Describe the safety aspects of transporting goods and people.
- State the advantages and limitations of various modes of material and/or people transportation systems such as railroads, automobiles, robots, mass transit, pipelines.
- Explain the pollution problems posed by the use of various transportation systems.
- Discuss ethical issues related to environmentalism, pollution, military surveillance, etc.
- Identify and discuss key economic factors related to energy and power applications, e.g. cost, scarcity, availability, etc.

Land & Water Transporation



Level 2 Introduction

- Label the component parts of a typical conveyor system and a typical elevator system. **[R: E-RB]**
- Match land and water transport vessels with appropriate products and cargo. **[R: E-RB]**

Level 2 Exploration

- State how robots are examples of energy and power technology as well as materials handling technology.
- Describe the components of transportation systems.
- To "Define by completing statements with appropriate..."

Level 3 Intermediate

- Construct robots that apply energy and power technology in a controlled manner.
- Analyze industrial equipment operation in terms of energy conversion, power transmission, and instrumentation & control systems.

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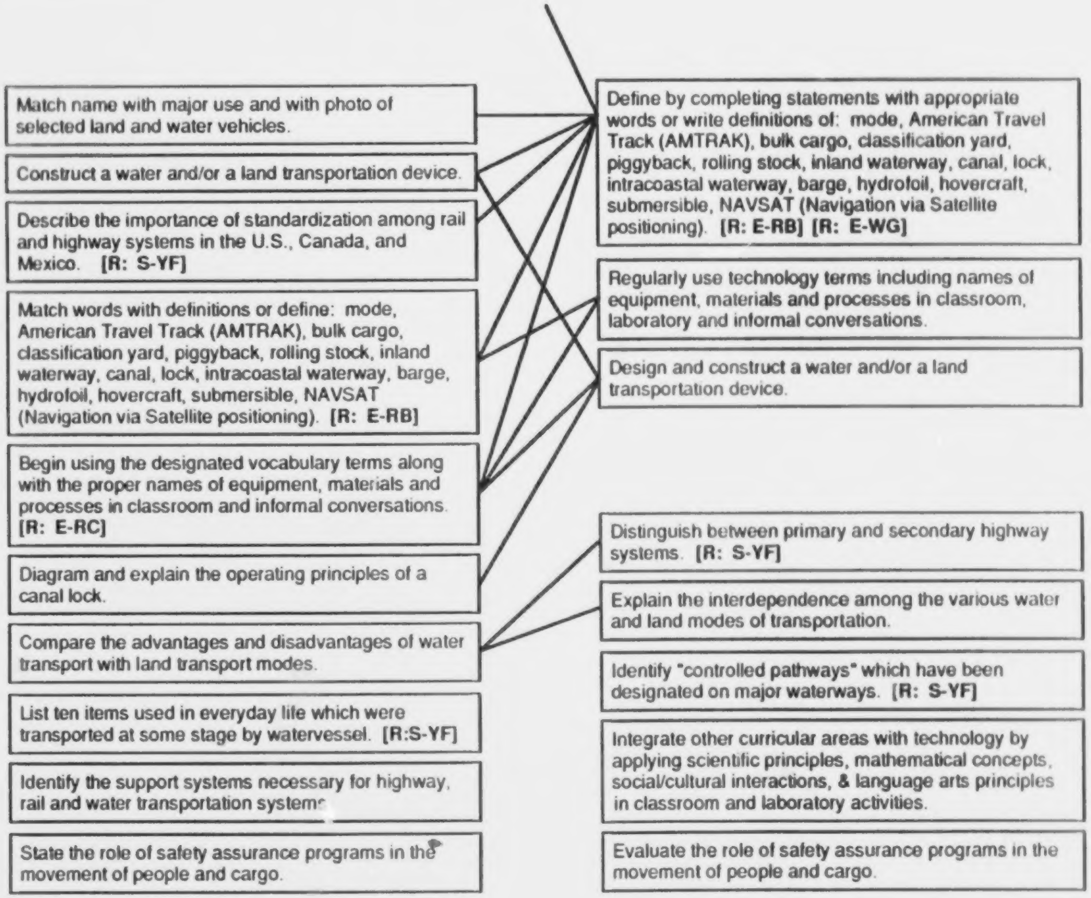
Land & Water Transporation (continued)



Level 2 Introduction

- Match name with major use and with photo of selected land and water vehicles.
- Construct a water and/or a land transportation device.
- Describe the importance of standardization among rail and highway systems in the U.S., Canada, and Mexico. **[R: S-YF]**
- Match words with definitions or define: mode, American Travel Track (AMTRAK), bulk cargo, classification yard, piggyback, rolling stock, inland waterway, canal, lock, intracoastal waterway, barge, hydrofoil, hovercraft, submersible, NAVSAT (Navigation via Satellite positioning). **[R: E-RB]**
- Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-RC]**
- Diagram and explain the operating principles of a canal lock.
- Compare the advantages and disadvantages of water transport with land transport modes.
- List ten items used in everyday life which were transported at some stage by watervessel. **[R:S-YF]**
- Identify the support systems necessary for highway, rail and water transportation systems.
- State the role of safety assurance programs in the movement of people and cargo.

Level 2 Exploration

- Define by completing statements with appropriate words or write definitions of: mode, American Travel Track (AMTRAK), bulk cargo, classification yard, piggyback, rolling stock, inland waterway, canal, lock, intracoastal waterway, barge, hydrofoil, hovercraft, submersible, NAVSAT (Navigation via Satellite positioning). **[R: E-RB] [R: E-WG]**
- Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations.
- Design and construct a water and/or a land transportation device.
- Distinguish between primary and secondary highway systems. **[R: S-YF]**
- Explain the interdependence among the various water and land modes of transportation.
- Identify "controlled pathways" which have been designated on major waterways. **[R: S-YF]**
- Integrate other curricular areas with technology by applying scientific principles, mathematical concepts, social/cultural interactions, & language arts principles in classroom and laboratory activities.
- Evaluate the role of safety assurance programs in the movement of people and cargo.

Strand #6: Energy & Power Technology

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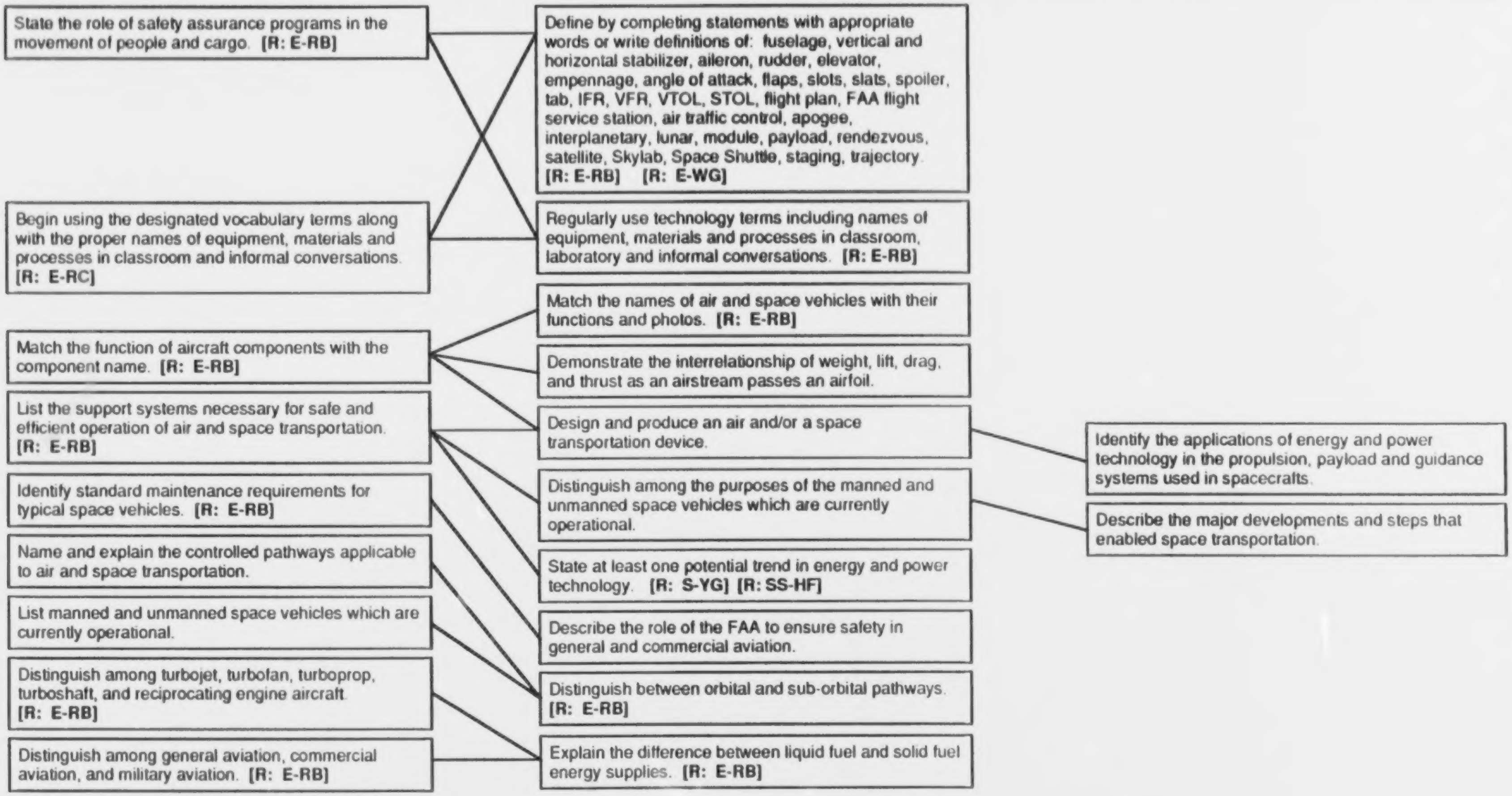
Air Transporation



Level 2 Introduction

- State the role of safety assurance programs in the movement of people and cargo. **[R: E-RB]**
- Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-RC]**
- Match the function of aircraft components with the component name. **[R: E-RB]**
- List the support systems necessary for safe and efficient operation of air and space transportation. **[R: E-RB]**
- Identify standard maintenance requirements for typical space vehicles. **[R: E-RB]**
- Name and explain the controlled pathways applicable to air and space transportation.
- List manned and unmanned space vehicles which are currently operational.
- Distinguish among turbojet, turbofan, turboprop, turboshaft, and reciprocating engine aircraft. **[R: E-RB]**
- Distinguish among general aviation, commercial aviation, and military aviation. **[R: E-RB]**

Level 2 Exploration

- Define by completing statements with appropriate words or write definitions of: fuselage, vertical and horizontal stabilizer, aileron, rudder, elevator, empennage, angle of attack, flaps, slots, slats, spoiler, tab, IFR, VFR, VTOL, STOL, flight plan, FAA flight service station, air traffic control, apogee, interplanetary, lunar, module, payload, rendezvous, satellite, Skylab, Space Shuttle, staging, trajectory. **[R: E-RB] [R: E-WG]**
- Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-RB]**
- Match the names of air and space vehicles with their functions and photos. **[R: E-RB]**
- Demonstrate the interrelationship of weight, lift, drag, and thrust as an airstream passes an airfoil.
- Design and produce an air and/or a space transportation device.
- Distinguish among the purposes of the manned and unmanned space vehicles which are currently operational.
- State at least one potential trend in energy and power technology. **[R: S-YG] [R: SS-HF]**
- Describe the role of the FAA to ensure safety in general and commercial aviation.
- Distinguish between orbital and sub-orbital pathways. **[R: E-RB]**
- Explain the difference between liquid fuel and solid fuel energy supplies. **[R: E-RB]**

Level 3 Intermediate

- Identify the applications of energy and power technology in the propulsion, payload and guidance systems used in spacecrafts.
- Describe the major developments and steps that enabled space transportation.

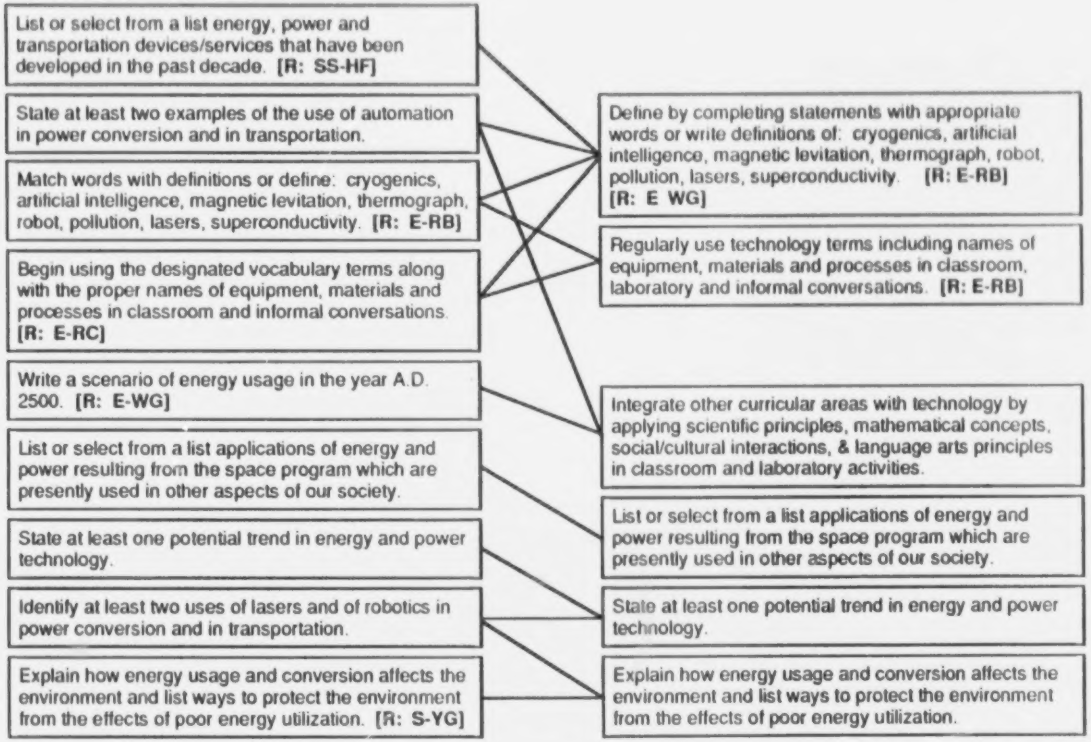
Strand #6: Energy & Power Technology

Level 2 Introduction	Level 2 Exploration	Level 3 Intermediate

Air Transporation (continued)

Level 2 Introduction	Level 2 Exploration	Level 3 Intermediate
Explain the difference between liquid fuel and solid fuel energy supplies.	Apply safety regulations in all classroom and laboratory activities.	Demonstrate proper safety precautions in working with model rockets.

Emerging Technologies



List or select from a list energy, power and transportation devices/services that have been developed in the past decade. **[R: SS-HF]**

State at least two examples of the use of automation in power conversion and in transportation.

Match words with definitions or define: cryogenics, artificial intelligence, magnetic levitation, thermograph, robot, pollution, lasers, superconductivity. **[R: E-RB]**

Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-RC]**

Write a scenario of energy usage in the year A.D. 2500. **[R: E-WG]**

List or select from a list applications of energy and power resulting from the space program which are presently used in other aspects of our society.

State at least one potential trend in energy and power technology.

Identify at least two uses of lasers and of robotics in power conversion and in transportation.

Explain how energy usage and conversion affects the environment and list ways to protect the environment from the effects of poor energy utilization. **[R: S-YG]**

Define by completing statements with appropriate words or write definitions of: cryogenics, artificial intelligence, magnetic levitation, thermograph, robot, pollution, lasers, superconductivity. **[R: E-RB]** **[R: E WG]**

Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-RB]**

Integrate other curricular areas with technology by applying scientific principles, mathematical concepts, social/cultural interactions, & language arts principles in classroom and laboratory activities.

List or select from a list applications of energy and power resulting from the space program which are presently used in other aspects of our society.

State at least one potential trend in energy and power technology.

Explain how energy usage and conversion affects the environment and list ways to protect the environment from the effects of poor energy utilization.

Strand #6: Energy & Power Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Emerging Technologies (continued)

Level 2 Introduction

Recognize that technological change is continuous, has an effect on humans, and is brought about by human action; therefore, each individual may assume a responsible role in directing technological change. **[R: S-YG]**

Gather pertinent information, formulate and express an opinion related to the social/cultural issues in energy and power technology. **[R: SS-GB]**

Write a scenario of energy usage in the year A.D. 2500. **[R: SS-WG]**

Level 2 Exploration

Gather pertinent information, formulate and express an opinion related to the social/cultural issues in energy and power technology. **[R:SS-XS] [R:SS-XT]**

Recognize the role of energy, power and transportation in influencing the level of technology of a community or a society. **[R:SS-XS] [R:SS-XT]**

Identify two energy, power and transportation devices/services that have been developed within the past decade, describe subsequent developments which have occurred, and state the current acceptance and uses.

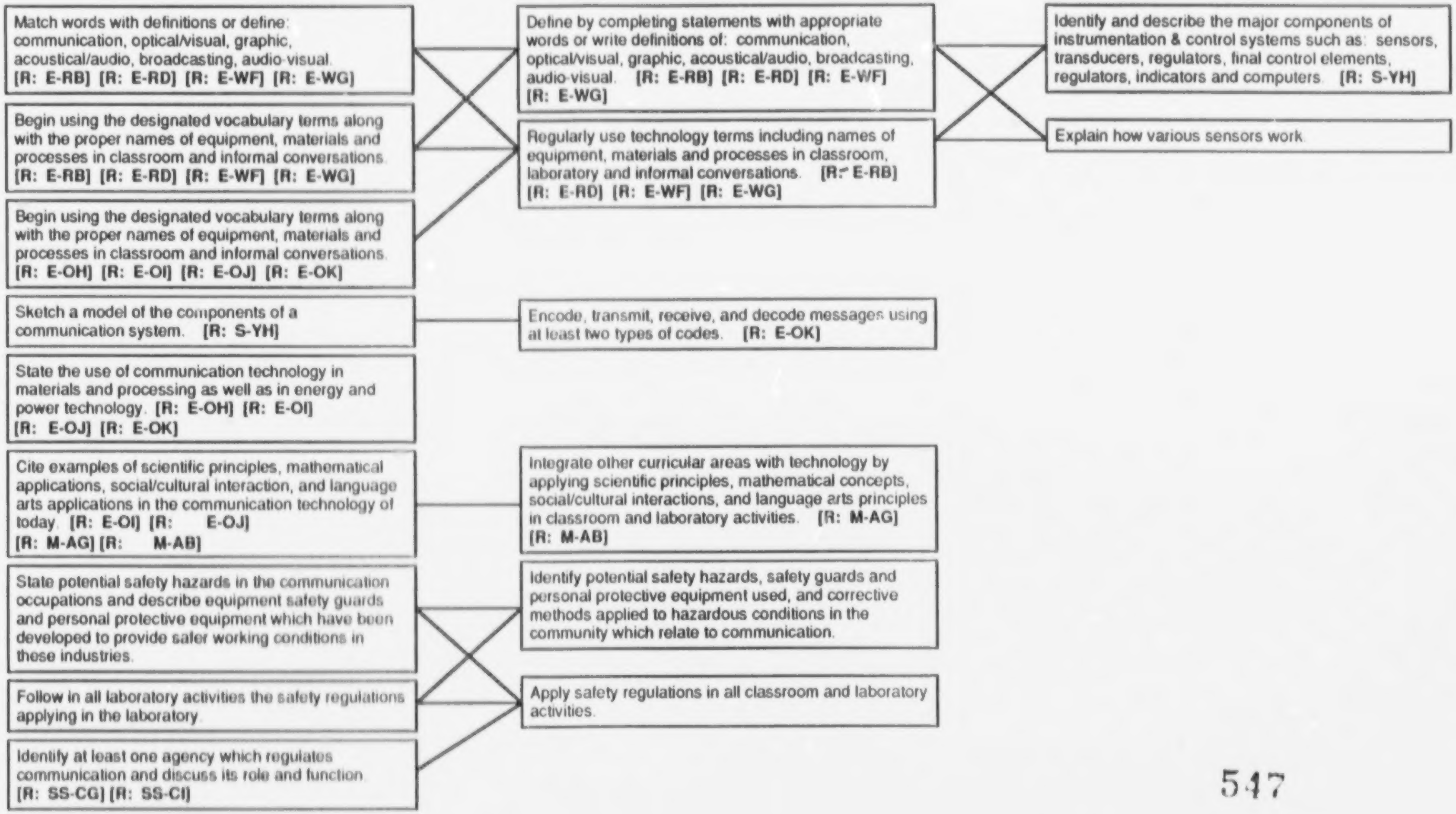
Level 3 Intermediate

Chart the basic trends of energy use and growth patterns. **[R: S-YF] [R: S-YG] [R: S-YH] [I : M- AD] [I : SS-HE] [I : SS-HF]**

Strand #7: Communication Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Signs, Symbols, & Technical Communication



Level 2 Introduction

Match words with definitions or define: communication, optical/visual, graphic, acoustical/audio, broadcasting, audio-visual. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-OH] [R: E-OI] [R: E-OJ] [R: E-OK]**

Sketch a model of the components of a communication system. **[R: S-YH]**

State the use of communication technology in materials and processing as well as in energy and power technology. **[R: E-OH] [R: E-OI] [R: E-OJ] [R: E-OK]**

Cite examples of scientific principles, mathematical applications, social/cultural interaction, and language arts applications in the communication technology of today. **[R: E-OI] [R: E-OJ] [R: M-AG] [R: M-AB]**

State potential safety hazards in the communication occupations and describe equipment safety guards and personal protective equipment which have been developed to provide safer working conditions in these industries.

Follow in all laboratory activities the safety regulations applying in the laboratory.

Identify at least one agency which regulates communication and discuss its role and function. **[R: SS-CG] [R: SS-CI]**

Level 2 Exploration

Define by completing statements with appropriate words or write definitions of: communication, optical/visual, graphic, acoustical/audio, broadcasting, audio-visual. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Encode, transmit, receive, and decode messages using at least two types of codes. **[R: E-OK]**

Integrate other curricular areas with technology by applying scientific principles, mathematical concepts, social/cultural interactions, and language arts principles in classroom and laboratory activities. **[R: M-AG] [R: M-AB]**

Identify potential safety hazards, safety guards and personal protective equipment used, and corrective methods applied to hazardous conditions in the community which relate to communication.

Apply safety regulations in all classroom and laboratory activities.

Level 3 Intermediate

Identify and describe the major components of instrumentation & control systems such as: sensors, transducers, regulators, final control elements, regulators, indicators and computers. **[R: S-YH]**

Explain how various sensors work.

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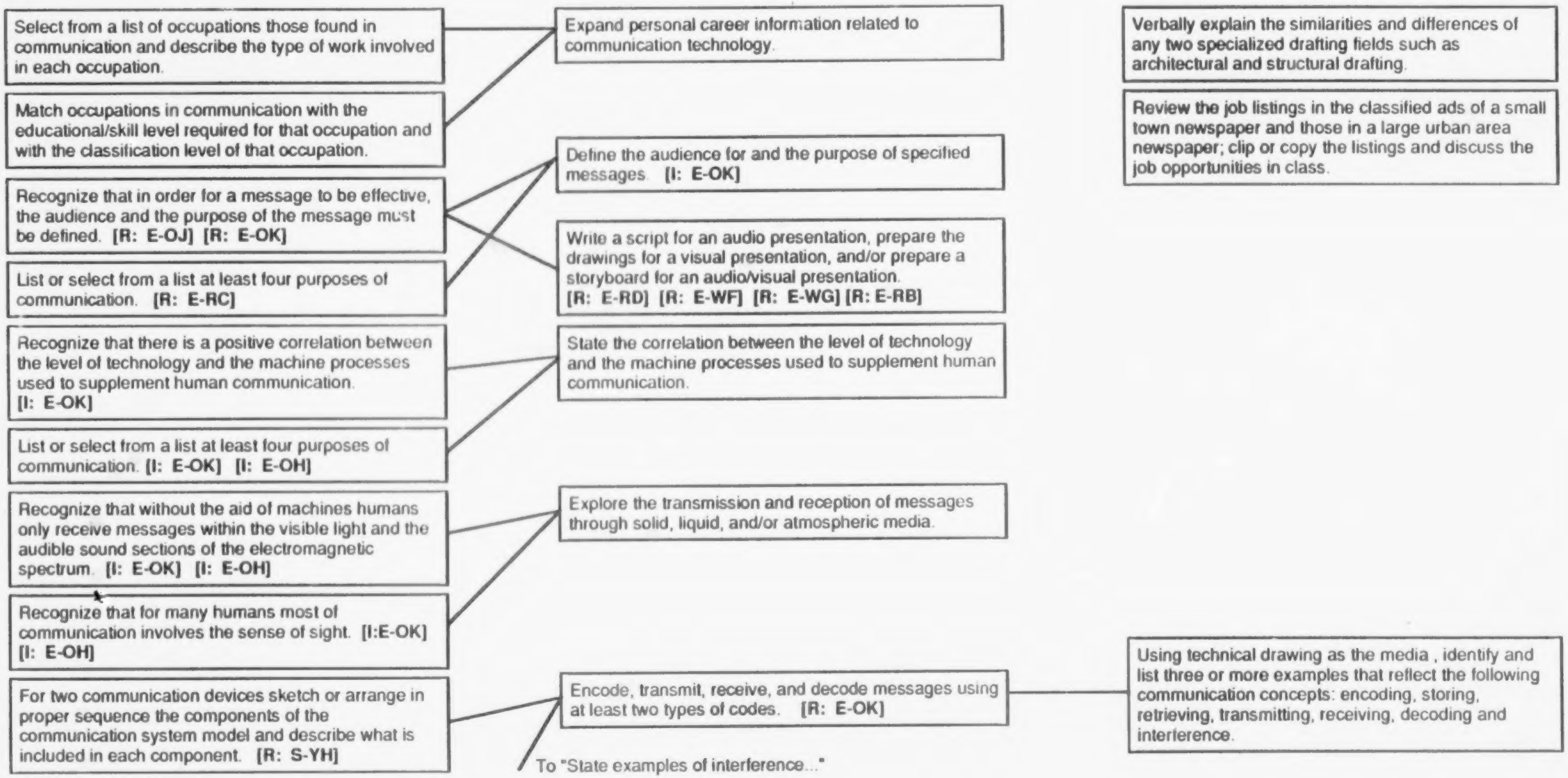
Strand #7: Communication Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Signs, Symbols, & Technical Communication (continued)



Level 2 Introduction

- Select from a list of occupations those found in communication and describe the type of work involved in each occupation.
- Match occupations in communication with the educational/skill level required for that occupation and with the classification level of that occupation.
- Recognize that in order for a message to be effective, the audience and the purpose of the message must be defined. **[R: E-OJ] [R: E-OK]**
- List or select from a list at least four purposes of communication. **[R: E-RC]**
- Recognize that there is a positive correlation between the level of technology and the machine processes used to supplement human communication. **[I: E-OK]**
- List or select from a list at least four purposes of communication. **[I: E-OK] [I: E-OH]**
- Recognize that without the aid of machines humans only receive messages within the visible light and the audible sound sections of the electromagnetic spectrum. **[I: E-OK] [I: E-OH]**
- Recognize that for many humans most of communication involves the sense of sight. **[I:E-OK] [I: E-OH]**
- For two communication devices sketch or arrange in proper sequence the components of the communication system model and describe what is included in each component. **[R: S-YH]**

Level 2 Exploration

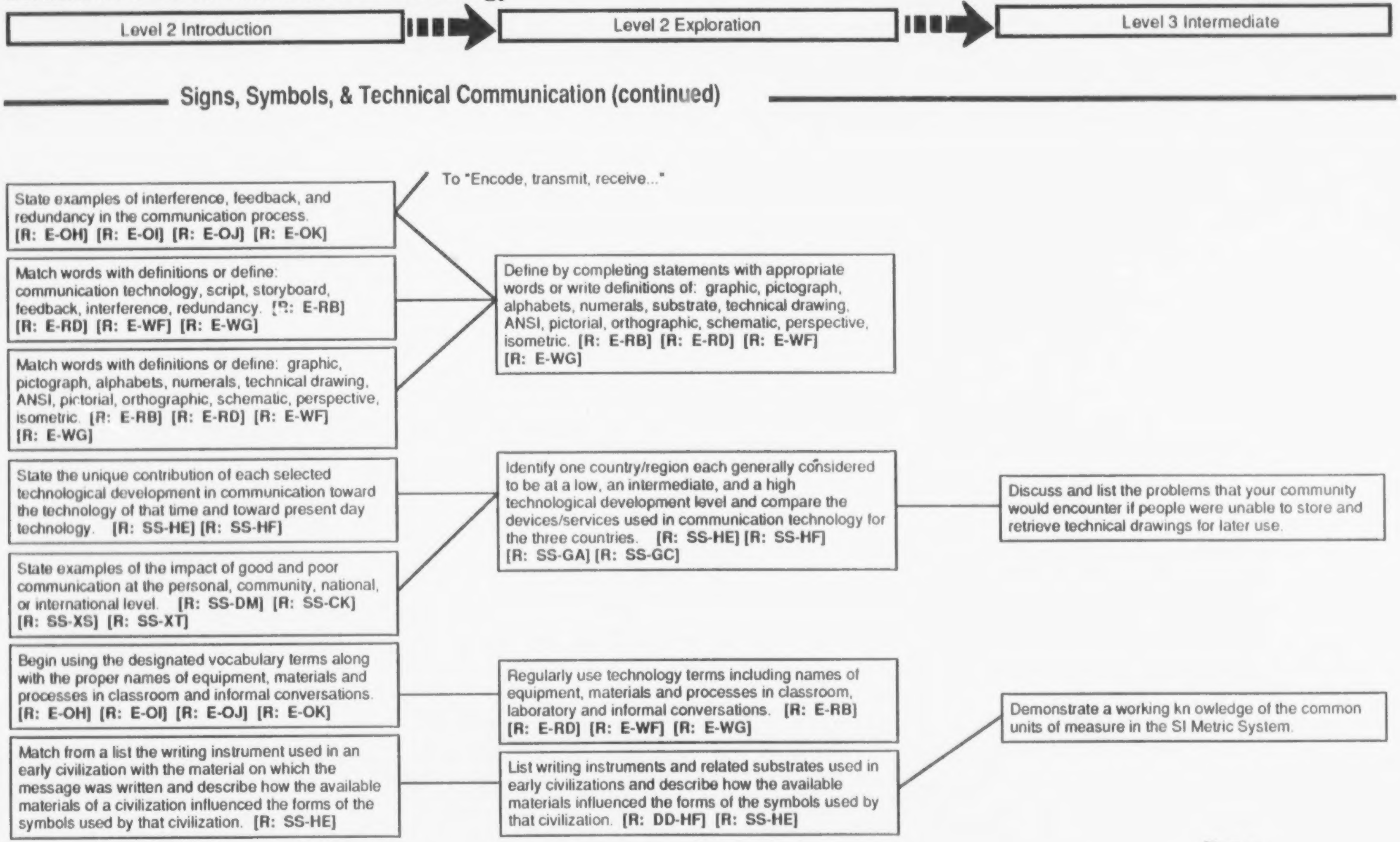
- Expand personal career information related to communication technology.
- Define the audience for and the purpose of specified messages. **[I: E-OK]**
- Write a script for an audio presentation, prepare the drawings for a visual presentation, and/or prepare a storyboard for an audio/visual presentation. **[R: E-RD] [R: E-WF] [R: E-WG] [R: E-RB]**
- State the correlation between the level of technology and the machine processes used to supplement human communication.
- Explore the transmission and reception of messages through solid, liquid, and/or atmospheric media.
- Encode, transmit, receive, and decode messages using at least two types of codes. **[R: E-OK]**

To "State examples of interference..."

Level 3 Intermediate

- Verbally explain the similarities and differences of any two specialized drafting fields such as architectural and structural drafting.
- Review the job listings in the classified ads of a small town newspaper and those in a large urban area newspaper; clip or copy the listings and discuss the job opportunities in class.
- Using technical drawing as the media , identify and list three or more examples that reflect the following communication concepts: encoding, storing, retrieving, transmitting, receiving, decoding and interference.

Strand #7: Communication Technology



Level 2 Introduction

Level 2 Exploration

Level 3 Intermediate

Signs, Symbols, & Technical Communication (continued)

State examples of interference, feedback, and redundancy in the communication process. **[R: E-OH] [R: E-OI] [R: E-OJ] [R: E-OK]**

To "Encode, transmit, receive..."

Match words with definitions or define: communication technology, script, storyboard, feedback, interference, redundancy. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Match words with definitions or define: graphic, pictograph, alphabets, numerals, technical drawing, ANSI, pictorial, orthographic, schematic, perspective, isometric. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

State the unique contribution of each selected technological development in communication toward the technology of that time and toward present day technology. **[R: SS-HE] [R: SS-HF]**

State examples of the impact of good and poor communication at the personal, community, national, or international level. **[R: SS-DM] [R: SS-CK] [R: SS-XS] [R: SS-XT]**

Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-OH] [R: E-OI] [R: E-OJ] [R: E-OK]**

Match from a list the writing instrument used in an early civilization with the material on which the message was written and describe how the available materials of a civilization influenced the forms of the symbols used by that civilization. **[R: SS-HE]**

Define by completing statements with appropriate words or write definitions of: graphic, pictograph, alphabets, numerals, substrate, technical drawing, ANSI, pictorial, orthographic, schematic, perspective, isometric. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Identify one country/region each generally considered to be at a low, an intermediate, and a high technological development level and compare the devices/services used in communication technology for the three countries. **[R: SS-HE] [R: SS-HF] [R: SS-GA] [R: SS-GC]**

Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

List writing instruments and related substrates used in early civilizations and describe how the available materials influenced the forms of the symbols used by that civilization. **[R: DD-HF] [R: SS-HE]**

Discuss and list the problems that your community would encounter if people were unable to store and retrieve technical drawings for later use.

Demonstrate a working knowledge of the common units of measure in the SI Metric System.

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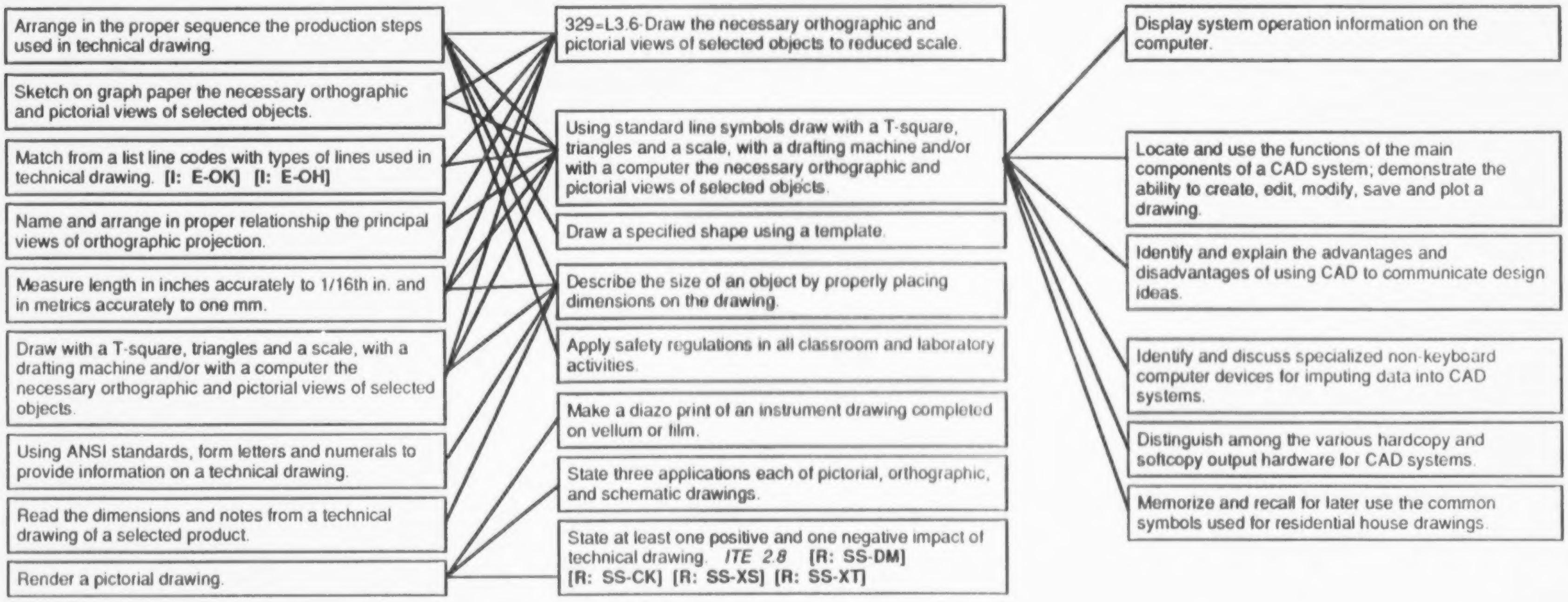
Strand #7: Communication Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Signs, Symbols, & Technical Communication (continued)



Level 2 Introduction

- Arrange in the proper sequence the production steps used in technical drawing.
- Sketch on graph paper the necessary orthographic and pictorial views of selected objects.
- Match from a list line codes with types of lines used in technical drawing. **[I: E-OK] [I: E-OH]**
- Name and arrange in proper relationship the principal views of orthographic projection.
- Measure length in inches accurately to 1/16th in. and in metrics accurately to one mm.
- Draw with a T-square, triangles and a scale, with a drafting machine and/or with a computer the necessary orthographic and pictorial views of selected objects.
- Using ANSI standards, form letters and numerals to provide information on a technical drawing.
- Read the dimensions and notes from a technical drawing of a selected product.
- Render a pictorial drawing.

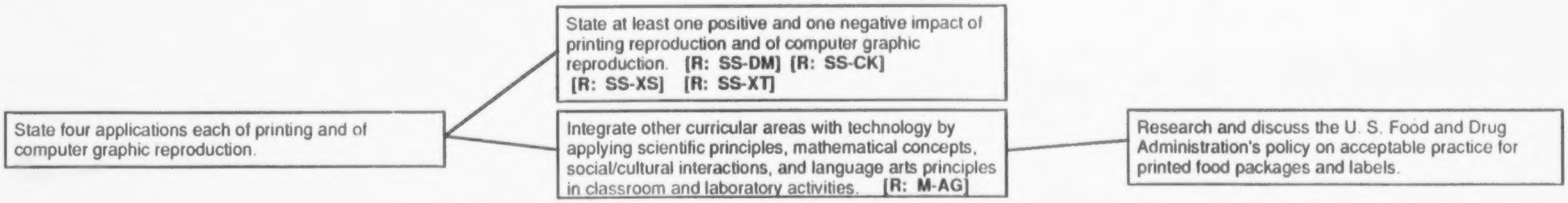
Level 2 Exploration

- 329=L3.6-Draw the necessary orthographic and pictorial views of selected objects to reduced scale.
- Using standard line symbols draw with a T-square, triangles and a scale, with a drafting machine and/or with a computer the necessary orthographic and pictorial views of selected objects.
- Draw a specified shape using a template.
- Describe the size of an object by properly placing dimensions on the drawing.
- Apply safety regulations in all classroom and laboratory activities.
- Make a diazo print of an instrument drawing completed on vellum or film.
- State three applications each of pictorial, orthographic, and schematic drawings.
- State at least one positive and one negative impact of technical drawing. *ITE 2.8* **[R: SS-DM] [R: SS-CK] [R: SS-XS] [R: SS-XT]**

Level 3 Intermediate

- Display system operation information on the computer.
- Locate and use the functions of the main components of a CAD system; demonstrate the ability to create, edit, modify, save and plot a drawing.
- Identify and explain the advantages and disadvantages of using CAD to communicate design ideas.
- Identify and discuss specialized non-keyboard computer devices for imputing data into CAD systems.
- Distinguish among the various hardcopy and softcopy output hardware for CAD systems.
- Memorize and recall for later use the common symbols used for residential house drawings.

Printing Systems for Communication



Level 2 Introduction

- State four applications each of printing and of computer graphic reproduction.

Level 2 Exploration

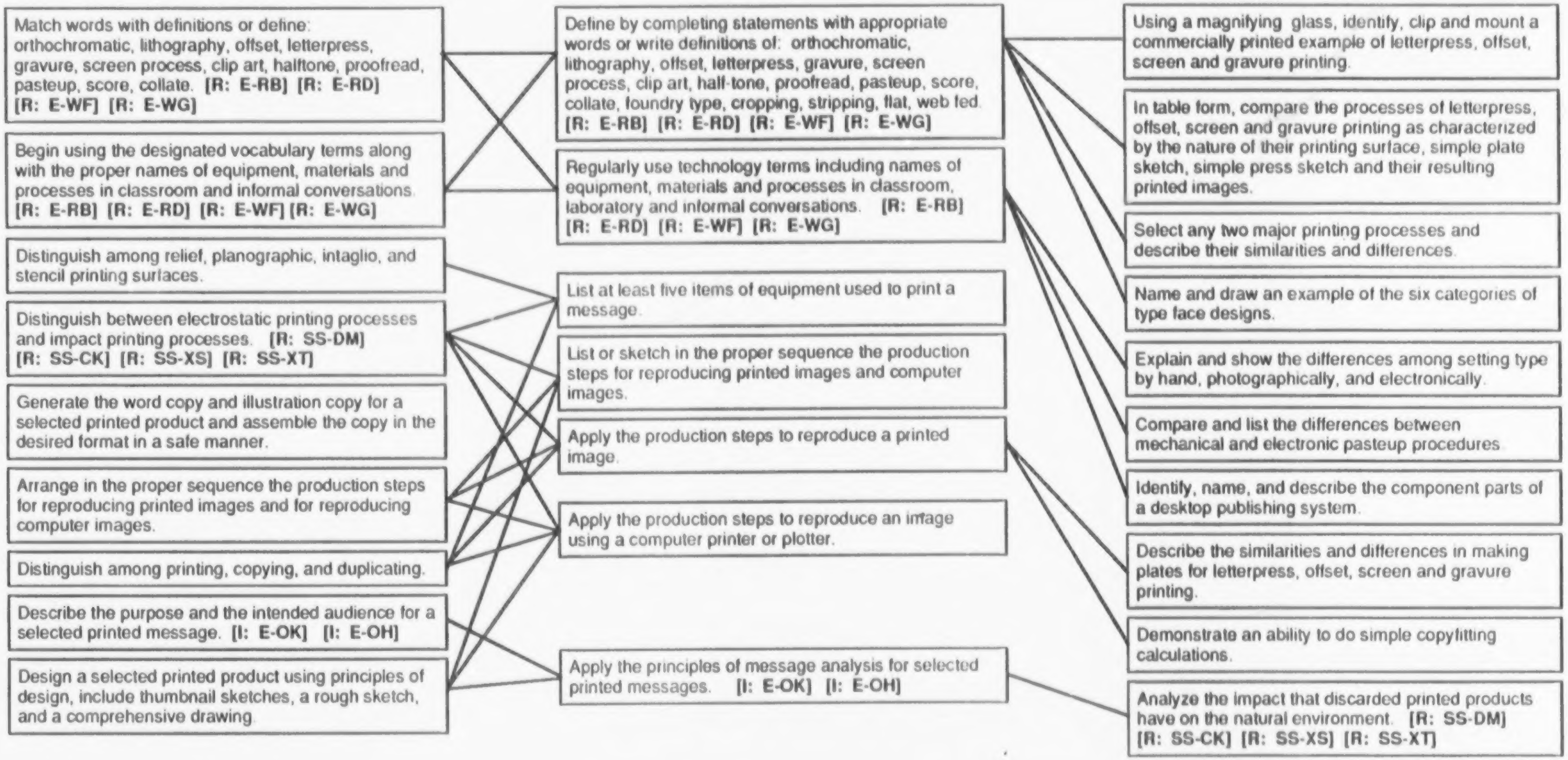
- State at least one positive and one negative impact of printing reproduction and of computer graphic reproduction. **[R: SS-DM] [R: SS-CK] [R: SS-XS] [R: SS-XT]**
- Integrate other curricular areas with technology by applying scientific principles, mathematical concepts, social/cultural interactions, and language arts principles in classroom and laboratory activities. **[R: M-AG]**

Level 3 Intermediate

- Research and discuss the U. S. Food and Drug Administration's policy on acceptable practice for printed food packages and labels.

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Printing Systems for Communication (continued)



Match words with definitions or define: orthochromatic, lithography, offset, letterpress, gravure, screen process, clip art, halftone, proofread, pasteup, score, collate. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Distinguish among relief, planographic, intaglio, and stencil printing surfaces.

Distinguish between electrostatic printing processes and impact printing processes. **[R: SS-DM] [R: SS-CK] [R: SS-XS] [R: SS-XT]**

Generate the word copy and illustration copy for a selected printed product and assemble the copy in the desired format in a safe manner.

Arrange in the proper sequence the production steps for reproducing printed images and for reproducing computer images.

Distinguish among printing, copying, and duplicating.

Describe the purpose and the intended audience for a selected printed message. **[I: E-OK] [I: E-OH]**

Design a selected printed product using principles of design, include thumbnail sketches, a rough sketch, and a comprehensive drawing.

Define by completing statements with appropriate words or write definitions of: orthochromatic, lithography, offset, letterpress, gravure, screen process, clip art, half-tone, proofread, pasteup, score, collate, foundry type, cropping, stripping, flat, web fed. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

List at least five items of equipment used to print a message.

List or sketch in the proper sequence the production steps for reproducing printed images and computer images.

Apply the production steps to reproduce a printed image.

Apply the production steps to reproduce an image using a computer printer or plotter.

Apply the principles of message analysis for selected printed messages. **[I: E-OK] [I: E-OH]**

Using a magnifying glass, identify, clip and mount a commercially printed example of letterpress, offset, screen and gravure printing.

In table form, compare the processes of letterpress, offset, screen and gravure printing as characterized by the nature of their printing surface, simple plate sketch, simple press sketch and their resulting printed images.

Select any two major printing processes and describe their similarities and differences.

Name and draw an example of the six categories of type face designs.

Explain and show the differences among setting type by hand, photographically, and electronically.

Compare and list the differences between mechanical and electronic pasteup procedures.

Identify, name, and describe the component parts of a desktop publishing system.

Describe the similarities and differences in making plates for letterpress, offset, screen and gravure printing.

Demonstrate an ability to do simple copyfitting calculations.

Analyze the impact that discarded printed products have on the natural environment. **[R: SS-DM] [R: SS-CK] [R: SS-XS] [R: SS-XT]**

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Printing Systems for Communication (continued)

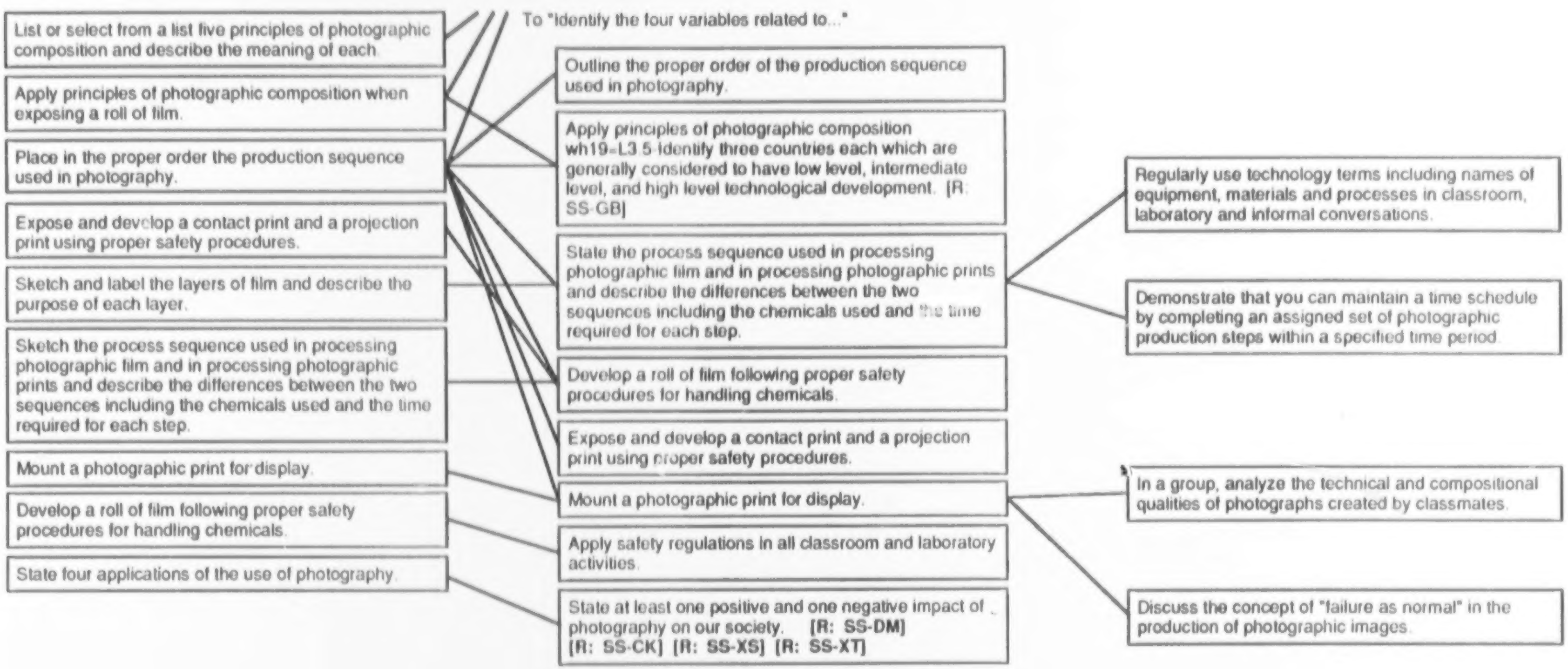
Level 2 Introduction	Level 2 Exploration	Level 3 Intermediate
Perform in a safe manner the photographic processes necessary for image conversion for a selected printed product. Prepare the image carrier and transfer or copy the image for a selected printed product in a safe manner. Complete in a safe manner the finishing and binding processes necessary for a selected printed product.	Apply safety regulations in all classroom and laboratory activities.	

Photographic Systems of Communication

Level 2 Introduction	Level 2 Exploration	Level 3 Intermediate
Match words with definitions or define: exposure, depth of field, aperture, F-stop, shutter, pixel, developer, stop bath, fixer, panchromatic, emulsion, antihalation layer, latent image. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]** Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**	Define by completing statements with appropriate words or write definitions of: exposure, depth of field, aperture, F-stop, shutter, pixel, developer, stop bath, fixer, panchromatic, emulsion, antihalation layer, latent image, continuous tone. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**	Define by completing statements with appropriate words or write definitions of: exposure, depth of field, aperture, F-stop, shutter, pixel, developer, stop bath, fixer, panchromatic, emulsion, antihalation layer, latent image, continuous tone. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**
	Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**	
Identify the basic parts of a camera and describe the purpose of each. Load film into camera, correctly expose film, and remove film from camera. List or select from a list the four variables related to exposure control and tell how each may be adjusted to coordinate with the others. **[I: E-OK] [I: E-OH]** Describe the relationship between reflected light from the subject and the image on a negative.	Identify the four variables related to exposure control and tell how each may be adjusted to provide proper exposure of a photo.	

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Photographic Systems of Communication (continued)



Level 2 Introduction

- List or select from a list five principles of photographic composition and describe the meaning of each.
- Apply principles of photographic composition when exposing a roll of film.
- Place in the proper order the production sequence used in photography.
- Expose and develop a contact print and a projection print using proper safety procedures.
- Sketch and label the layers of film and describe the purpose of each layer.
- Sketch the process sequence used in processing photographic film and in processing photographic prints and describe the differences between the two sequences including the chemicals used and the time required for each step.
- Mount a photographic print for display.
- Develop a roll of film following proper safety procedures for handling chemicals.
- State four applications of the use of photography.

Level 2 Exploration

To "Identify the four variables related to..."

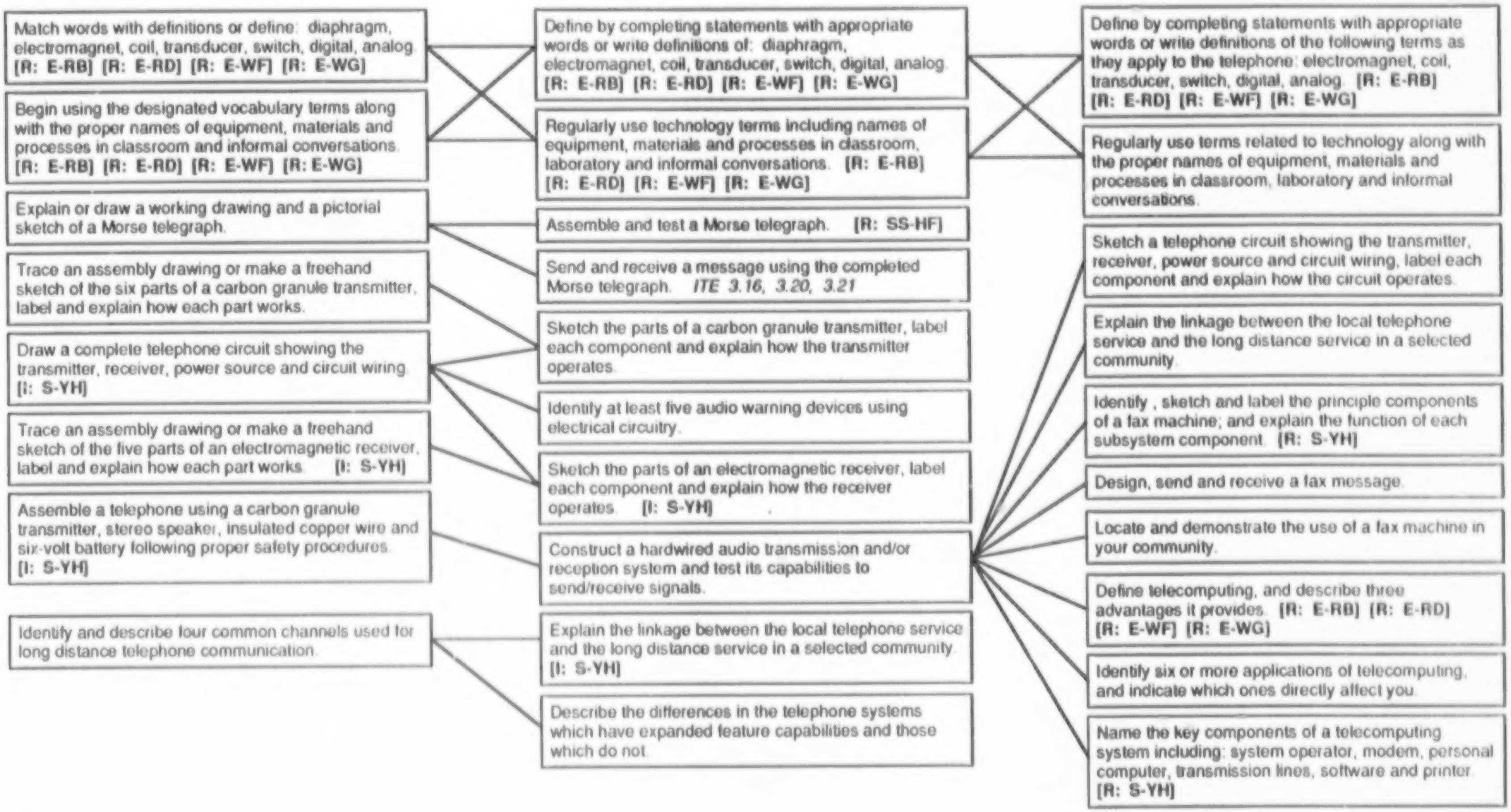
- Outline the proper order of the production sequence used in photography.
- Apply principles of photographic composition wh19=L3.5-Identify three countries each which are generally considered to have low level, intermediate level, and high level technological development. [R: SS-GB]
- State the process sequence used in processing photographic film and in processing photographic prints and describe the differences between the two sequences including the chemicals used and the time required for each step.
- Develop a roll of film following proper safety procedures for handling chemicals.
- Expose and develop a contact print and a projection print using proper safety procedures.
- Mount a photographic print for display.
- Apply safety regulations in all classroom and laboratory activities.
- State at least one positive and one negative impact of photography on our society. [R: SS-DM] [R: SS-CK] [R: SS-XS] [R: SS-XT]

Level 3 Intermediate

- Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations.
- Demonstrate that you can maintain a time schedule by completing an assigned set of photographic production steps within a specified time period.
- In a group, analyze the technical and compositional qualities of photographs created by classmates.
- Discuss the concept of "failure as normal" in the production of photographic images.

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Telecommunications-Hardwired



Level 2 Introduction

Match words with definitions or define: diaphragm, electromagnet, coil, transducer, switch, digital, analog. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Explain or draw a working drawing and a pictorial sketch of a Morse telegraph.

Trace an assembly drawing or make a freehand sketch of the six parts of a carbon granule transmitter, label and explain how each part works.

Draw a complete telephone circuit showing the transmitter, receiver, power source and circuit wiring. **[I: S-YH]**

Trace an assembly drawing or make a freehand sketch of the five parts of an electromagnetic receiver, label and explain how each part works. **[I: S-YH]**

Assemble a telephone using a carbon granule transmitter, stereo speaker, insulated copper wire and six-volt battery following proper safety procedures. **[I: S-YH]**

Identify and describe four common channels used for long distance telephone communication.

Level 2 Exploration

Define by completing statements with appropriate words or write definitions of: diaphragm, electromagnet, coil, transducer, switch, digital, analog. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Assemble and test a Morse telegraph. **[R: SS-HF]**

Send and receive a message using the completed Morse telegraph. *ITE 3.16, 3.20, 3.21*

Sketch the parts of a carbon granule transmitter, label each component and explain how the transmitter operates.

Identify at least five audio warning devices using electrical circuitry.

Sketch the parts of an electromagnetic receiver, label each component and explain how the receiver operates. **[I: S-YH]**

Construct a hardwired audio transmission and/or reception system and test its capabilities to send/receive signals.

Explain the linkage between the local telephone service and the long distance service in a selected community. **[I: S-YH]**

Describe the differences in the telephone systems which have expanded feature capabilities and those which do not.

Level 3 Intermediate

Define by completing statements with appropriate words or write definitions of the following terms as they apply to the telephone: electromagnet, coil, transducer, switch, digital, analog. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Regularly use terms related to technology along with the proper names of equipment, materials and processes in classroom, laboratory and informal conversations.

Sketch a telephone circuit showing the transmitter, receiver, power source and circuit wiring, label each component and explain how the circuit operates.

Explain the linkage between the local telephone service and the long distance service in a selected community.

Identify, sketch and label the principle components of a fax machine; and explain the function of each subsystem component. **[R: S-YH]**

Design, send and receive a fax message.

Locate and demonstrate the use of a fax machine in your community.

Define telecomputing, and describe three advantages it provides. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Identify six or more applications of telecomputing, and indicate which ones directly affect you.

Name the key components of a telecomputing system including: system operator, modem, personal computer, transmission lines, software and printer. **[R: S-YH]**

Strand #7: Communication Technology

Telecommunications-Hardwired (continued)

To "Construct a hardwired audio..."

Level 2 Introduction	Level 2 Exploration	Level 3 Intermediate
Draw a complete public address circuit schematic showing the microphone, speakers, power source, and circuit wiring. **[I: S-YH]**	Sketch a public address circuit showing the microphone, speakers, power source, and circuit wiring; label each component and explain how it operates. **[I: S-YH]**	Experience telecomputing by using a personal computer and modem in your school or community by accessing a local bulletin board, and a long distance data base.
Explain the importance of insulated wire in an electromagnet.	Apply safety regulations in all classroom and laboratory activities.	Explain the importance of the American Standard Code of International Information (ASCII).
Write a report describing the invention of an acoustical communication device. **[R: E-RB]**	State at least one positive and one negative impact of the telegraph and the telephone. **[R: SS-XT]** **[R: SS-DM]** **[R: SS-CK]** **[R: SS-XS]**	Compare and contrast fiber optic and copper wire transmission systems.
		Assemble and explain the electronic principles underlying the operation of a home security system.

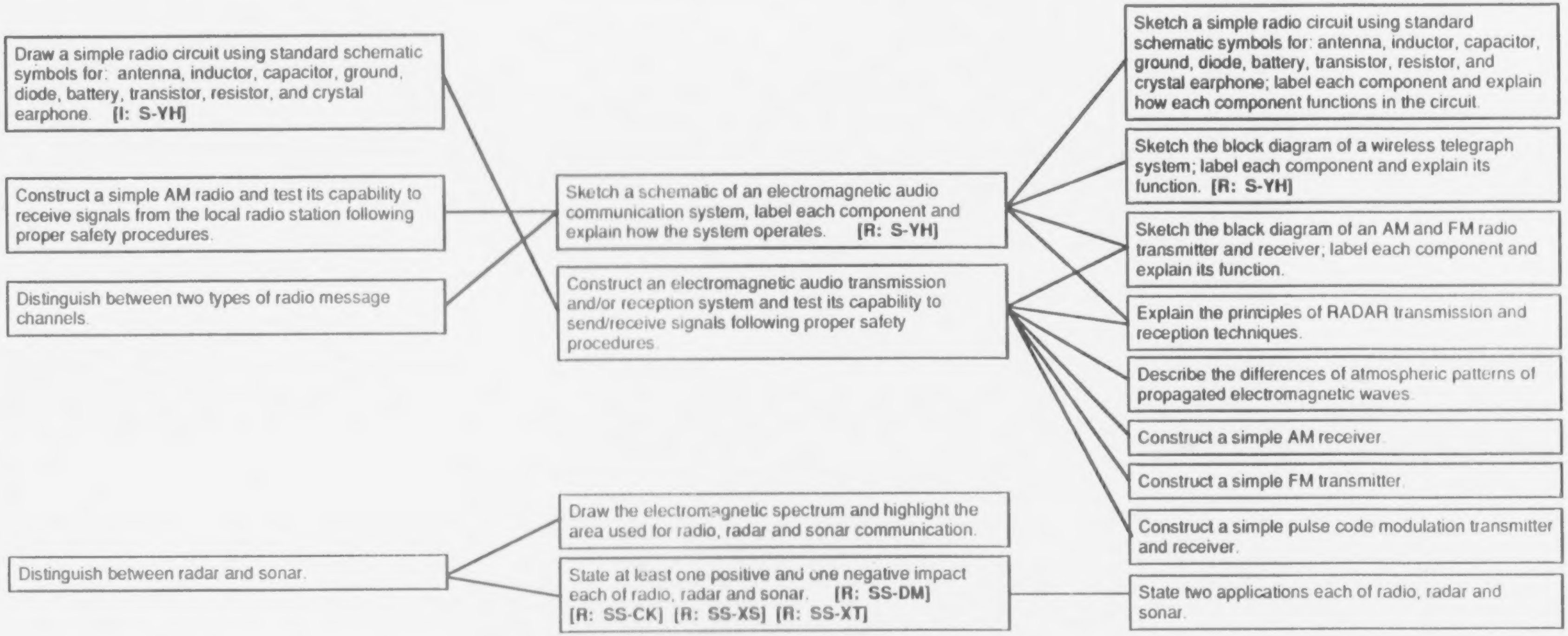
Telecommunications-Electromagnetic

Level 2 Introduction	Level 2 Exploration	Level 3 Intermediate
Match words with definitions or define: volt, ampere, ohm, Hertz, Henry, Farad. **[R: E-RB]** **[R: E-RD]** **[R: E-WF]** **[R: E-WG]**	Define by completing statements with appropriate words or write definitions of: volt, ampere, ohm, Hertz, Henry, Farad. **[R: E-RB]** **[R: E-RD]** **[R: E-WF]** **[R: E-WG]**	Define the terms electromagnetic transmit, receive, modulation , multiplexing, duplexing and frequency selecting.
Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-RB]** **[R: E-RD]** **[R: E-WF]** **[R: E-WG]**	Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-RB]** **[R: E-RD]** **[R: E-WF]** **[R: E-WG]**	Explain the difference between pulse modulation, pulse code, frequency, and amplitude modulation.
Distinguish between the wireless telegraph and the radio.	Describe the function of each of the components of a simple radio. **[R: S-YH]**	Explain how the frequency spectrum is subdivided into YLF, LF, MF, HF, VHF, SHF, and EHF.
Match each of the following electrical concepts with an electrical unit of measure: electrical push, electric current, electrical resistance, inductance, capacitance, and frequency. **[R: M-AD]**	Discuss each of the following electrical concepts: radio transmitter, electromagnetic signal, radio receiver, tuning circuit, amplifying circuit, alternating current, direct current, and piezoelectric effect.	

Strand #7: Communication Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Telecommunications-Electromagnetic (continued)



Draw a simple radio circuit using standard schematic symbols for: antenna, inductor, capacitor, ground, diode, battery, transistor, resistor, and crystal earphone. **[I: S-YH]**

Construct a simple AM radio and test its capability to receive signals from the local radio station following proper safety procedures.

Distinguish between two types of radio message channels.

Distinguish between radar and sonar.

Sketch a schematic of an electromagnetic audio communication system, label each component and explain how the system operates. **[R: S-YH]**

Construct an electromagnetic audio transmission and/or reception system and test its capability to send/receive signals following proper safety procedures.

Draw the electromagnetic spectrum and highlight the area used for radio, radar and sonar communication.

State at least one positive and one negative impact each of radio, radar and sonar. **[R: SS-DM]** **[R: SS-CK]** **[R: SS-XS]** **[R: SS-XT]**

Sketch a simple radio circuit using standard schematic symbols for: antenna, inductor, capacitor, ground, diode, battery, transistor, resistor, and crystal earphone; label each component and explain how each component functions in the circuit.

Sketch the block diagram of a wireless telegraph system; label each component and explain its function. **[R: S-YH]**

Sketch the black diagram of an AM and FM radio transmitter and receiver; label each component and explain its function.

Explain the principles of RADAR transmission and reception techniques.

Describe the differences of atmospheric patterns of propagated electromagnetic waves.

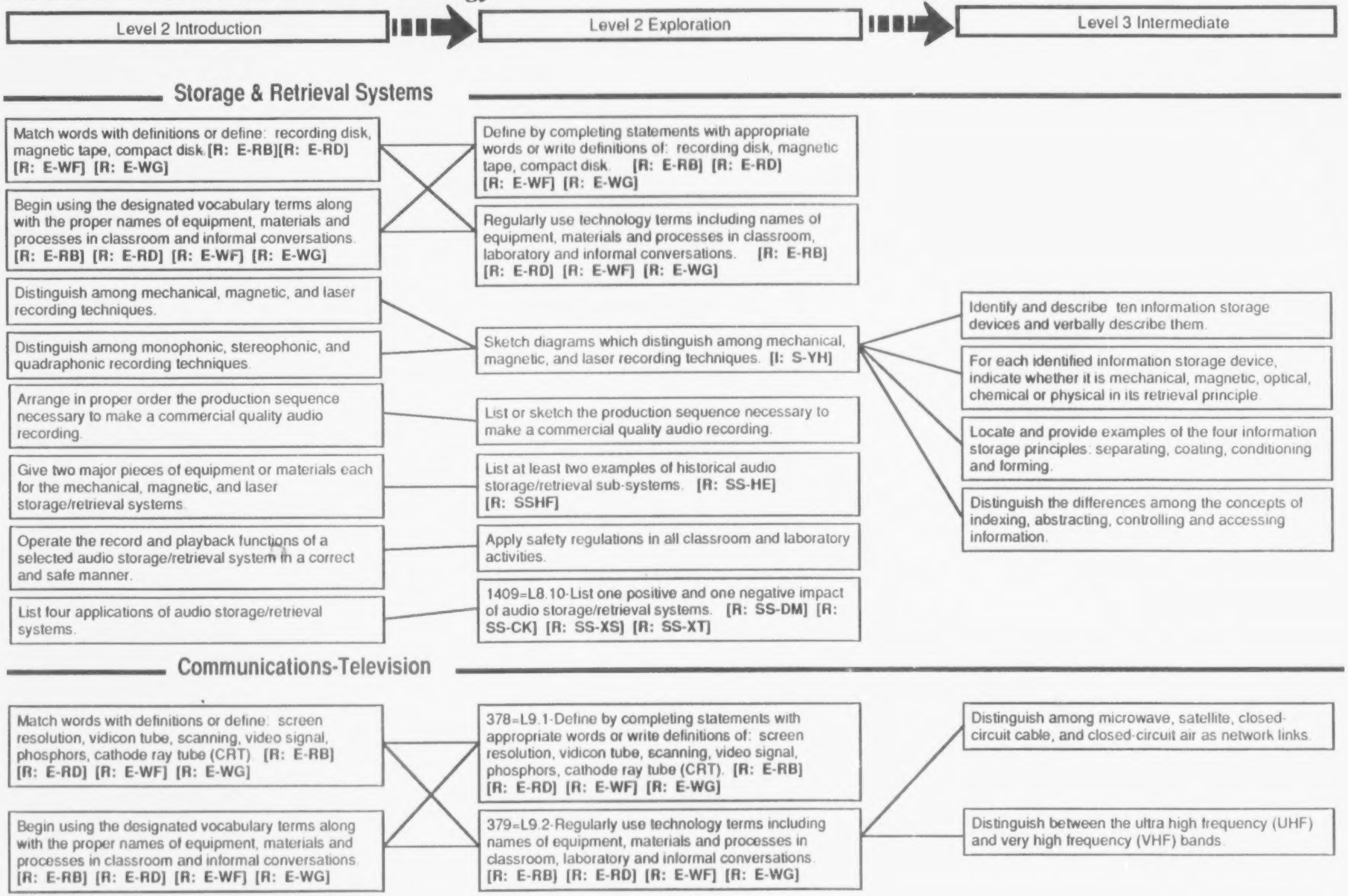
Construct a simple AM receiver.

Construct a simple FM transmitter.

Construct a simple pulse code modulation transmitter and receiver.

State two applications each of radio, radar and sonar.

Strand #7: Communication Technology



Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Storage & Retrieval Systems

Level 2 Introduction

Match words with definitions or define: recording disk, magnetic tape, compact disk. [R: E-RB][R: E-RD] [R: E-WF] [R: E-WG]

Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. [R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]

Distinguish among mechanical, magnetic, and laser recording techniques.

Distinguish among monophonic, stereophonic, and quadraphonic recording techniques.

Arrange in proper order the production sequence necessary to make a commercial quality audio recording.

Give two major pieces of equipment or materials each for the mechanical, magnetic, and laser storage/retrieval systems.

Operate the record and playback functions of a selected audio storage/retrieval system in a correct and safe manner.

List four applications of audio storage/retrieval systems.

Level 2 Exploration

Define by completing statements with appropriate words or write definitions of: recording disk, magnetic tape, compact disk. [R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]

Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. [R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]

Sketch diagrams which distinguish among mechanical, magnetic, and laser recording techniques. [I: S-YH]

List or sketch the production sequence necessary to make a commercial quality audio recording.

List at least two examples of historical audio storage/retrieval sub-systems. [R: SS-HE] [R: SSHF]

Apply safety regulations in all classroom and laboratory activities.

1409=L8.10-List one positive and one negative impact of audio storage/retrieval systems. [R: SS-DM] [R: SS-CK] [R: SS-XS] [R: SS-XT]

Level 3 Intermediate

Identify and describe ten information storage devices and verbally describe them.

For each identified information storage device, indicate whether it is mechanical, magnetic, optical, chemical or physical in its retrieval principle.

Locate and provide examples of the four information storage principles: separating, coating, conditioning and forming.

Distinguish the differences among the concepts of indexing, abstracting, controlling and accessing information.

Communications-Television

Level 2 Introduction

Match words with definitions or define: screen resolution, vidicon tube, scanning, video signal, phosphors, cathode ray tube (CRT). [R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]

Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. [R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]

Level 2 Exploration

378=L9.1-Define by completing statements with appropriate words or write definitions of: screen resolution, vidicon tube, scanning, video signal, phosphors, cathode ray tube (CRT). [R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]

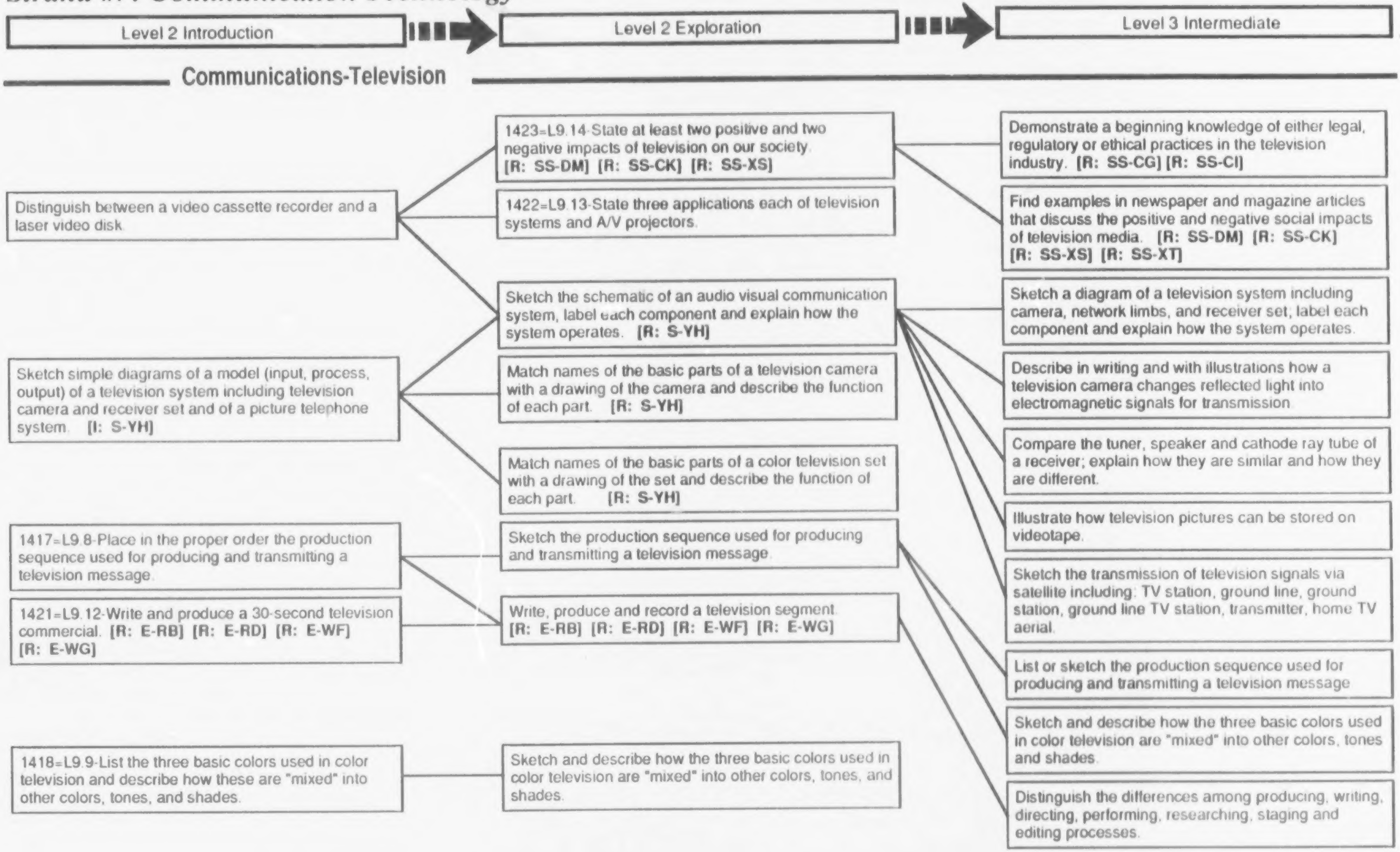
379=L9.2-Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. [R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]

Level 3 Intermediate

Distinguish among microwave, satellite, closed-circuit cable, and closed-circuit air as network links.

Distinguish between the ultra high frequency (UHF) and very high frequency (VHF) bands.

Strand #7: Communication Technology



Level 2 Introduction

Level 2 Exploration

Level 3 Intermediate

Communications-Television

Level 2 Introduction

Distinguish between a video cassette recorder and a laser video disk.

Sketch simple diagrams of a model (input, process, output) of a television system including television camera and receiver set and of a picture telephone system. **[I: S-YH]**

1417=L9.8-Place in the proper order the production sequence used for producing and transmitting a television message.

1421=L9.12-Write and produce a 30-second television commercial. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

1418=L9.9-List the three basic colors used in color television and describe how these are "mixed" into other colors, tones, and shades.

Level 2 Exploration

1423=L9.14-State at least two positive and two negative impacts of television on our society. **[R: SS-DM] [R: SS-CK] [R: SS-XS]**

1422=L9.13-State three applications each of television systems and A/V projectors.

Sketch the schematic of an audio visual communication system, label each component and explain how the system operates. **[R: S-YH]**

Match names of the basic parts of a television camera with a drawing of the camera and describe the function of each part. **[R: S-YH]**

Match names of the basic parts of a color television set with a drawing of the set and describe the function of each part. **[R: S-YH]**

Sketch the production sequence used for producing and transmitting a television message.

Write, produce and record a television segment. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Sketch and describe how the three basic colors used in color television are "mixed" into other colors, tones, and shades.

Level 3 Intermediate

Demonstrate a beginning knowledge of either legal, regulatory or ethical practices in the television industry. **[R: SS-CG] [R: SS-CI]**

Find examples in newspaper and magazine articles that discuss the positive and negative social impacts of television media. **[R: SS-DM] [R: SS-CK] [R: SS-XS] [R: SS-XT]**

Sketch a diagram of a television system including camera, network limbs, and receiver set; label each component and explain how the system operates.

Describe in writing and with illustrations how a television camera changes reflected light into electromagnetic signals for transmission.

Compare the tuner, speaker and cathode ray tube of a receiver; explain how they are similar and how they are different.

Illustrate how television pictures can be stored on videotape.

Sketch the transmission of television signals via satellite including: TV station, ground line, ground station, ground line TV station, transmitter, home TV aerial.

List or sketch the production sequence used for producing and transmitting a television message.

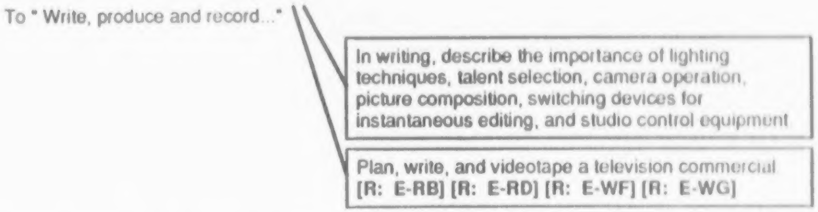
Sketch and describe how the three basic colors used in color television are "mixed" into other colors, tones and shades.

Distinguish the differences among producing, writing, directing, performing, researching, staging and editing processes.

Strand #7: Communication Technology

Level 2 Introduction | Level 2 Exploration | Level 3 Intermediate

Communications-Television (continued)

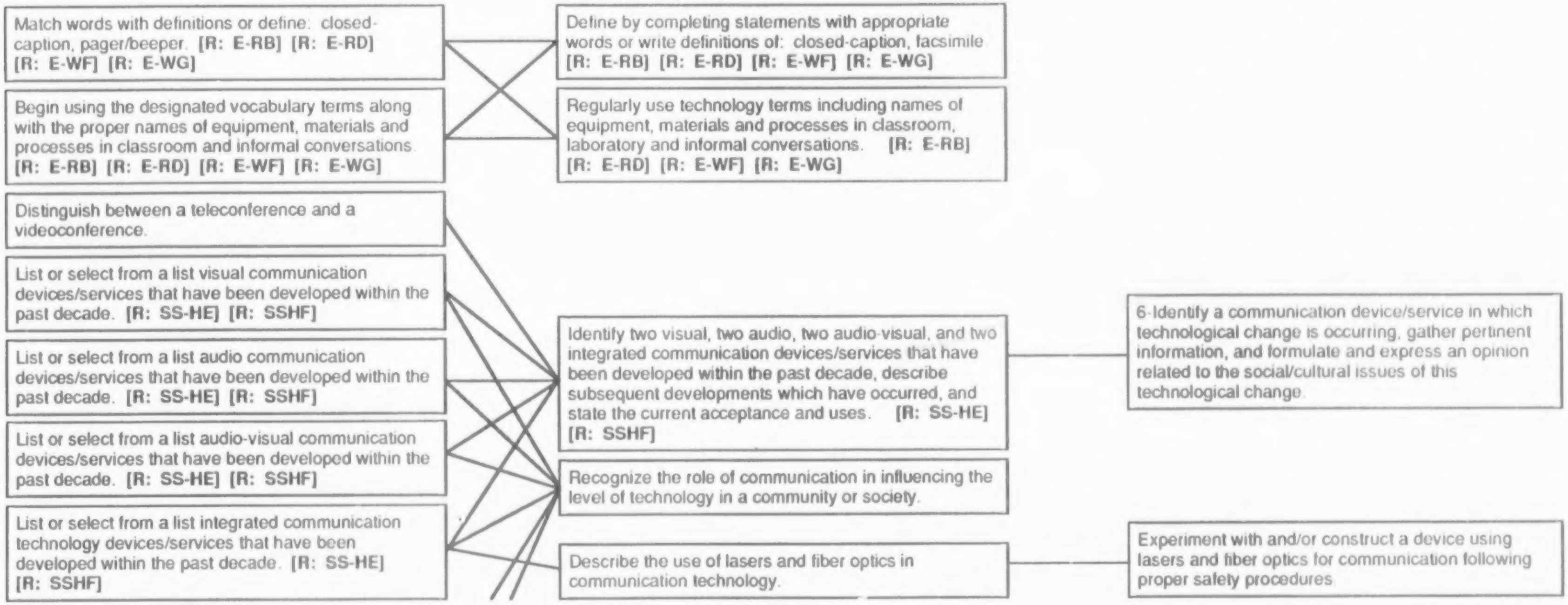


To " Write, produce and record..."

Level 3 Intermediate

- In writing, describe the importance of lighting techniques, talent selection, camera operation, picture composition, switching devices for instantaneous editing, and studio control equipment
- Plan, write, and videotape a television commercial **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Communications-Audio-visual



Level 2 Introduction

- Match words with definitions or define: closed-caption, pager/beeper. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**
- Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**
- Distinguish between a teleconference and a videoconference.
- List or select from a list visual communication devices/services that have been developed within the past decade. **[R: SS-HE] [R: SSHF]**
- List or select from a list audio communication devices/services that have been developed within the past decade. **[R: SS-HE] [R: SSHF]**
- List or select from a list audio-visual communication devices/services that have been developed within the past decade. **[R: SS-HE] [R: SSHF]**
- List or select from a list integrated communication technology devices/services that have been developed within the past decade. **[R: SS-HE] [R: SSHF]**

Level 2 Exploration

- Define by completing statements with appropriate words or write definitions of: closed-caption, facsimile **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**
- Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**
- Identify two visual, two audio, two audio-visual, and two integrated communication devices/services that have been developed within the past decade, describe subsequent developments which have occurred, and state the current acceptance and uses. **[R: SS-HE] [R: SSHF]**
- Recognize the role of communication in influencing the level of technology in a community or society.
- Describe the use of lasers and fiber optics in communication technology.

Level 3 Intermediate

- 6-Identify a communication device/service in which technological change is occurring, gather pertinent information, and formulate and express an opinion related to the social/cultural issues of this technological change.
- Experiment with and/or construct a device using lasers and fiber optics for communication following proper safety procedures

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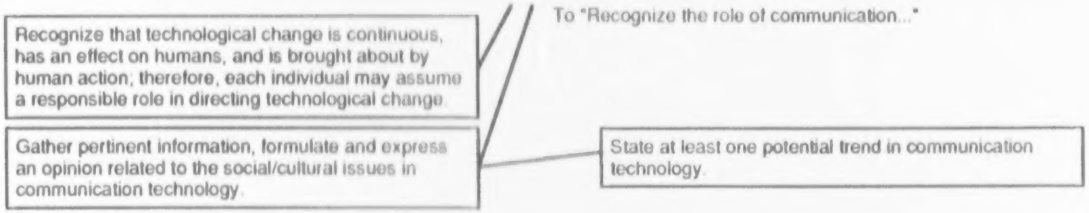
Strand #7: Communication Technology

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Communications-Audio-visual (continued)



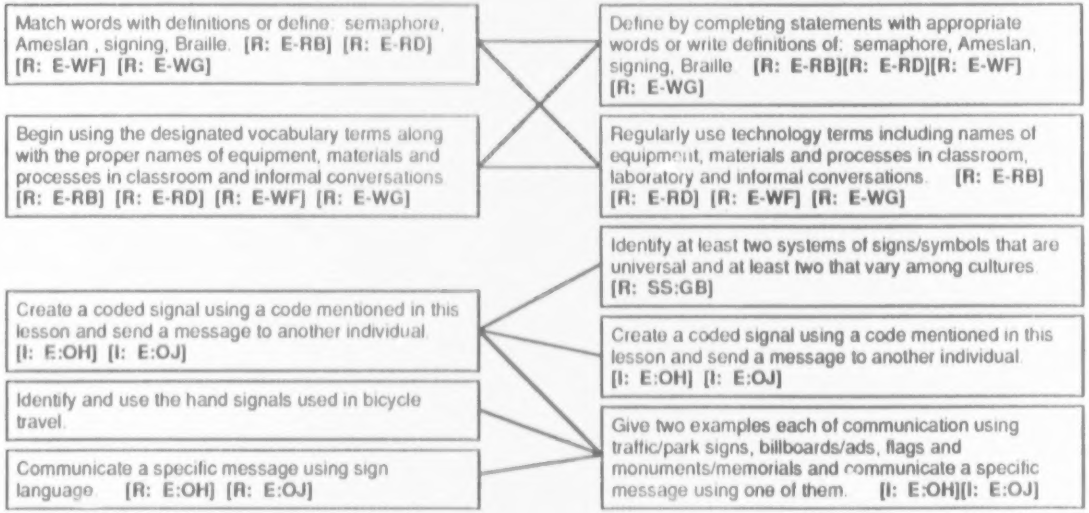
To "Recognize the role of communication..."

Recognize that technological change is continuous, has an effect on humans, and is brought about by human action; therefore, each individual may assume a responsible role in directing technological change.

Gather pertinent information, formulate and express an opinion related to the social/cultural issues in communication technology.

State at least one potential trend in communication technology.

Static Communication



Match words with definitions or define: semaphore, Ameslan , signing, Braille. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Begin using the designated vocabulary terms along with the proper names of equipment, materials and processes in classroom and informal conversations. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Create a coded signal using a code mentioned in this lesson and send a message to another individual. **[I: E:OH] [I: E:OJ]**

Identify and use the hand signals used in bicycle travel.

Communicate a specific message using sign language. **[R: E:OH] [R: E:OJ]**

Define by completing statements with appropriate words or write definitions of: semaphore, Ameslan, signing, Braille. **[R: E-RB][R: E-RD][R: E-WF] [R: E-WG]**

Regularly use technology terms including names of equipment, materials and processes in classroom, laboratory and informal conversations. **[R: E-RB] [R: E-RD] [R: E-WF] [R: E-WG]**

Identify at least two systems of signs/symbols that are universal and at least two that vary among cultures. **[R: SS:GB]**

Create a coded signal using a code mentioned in this lesson and send a message to another individual. **[I: E:OH] [I: E:OJ]**

Give two examples each of communication using traffic/park signs, billboards/ads, flags and monuments/memorials and communicate a specific message using one of them. **[I: E:OH][I: E:OJ]**

Strand #7: Communication Technology

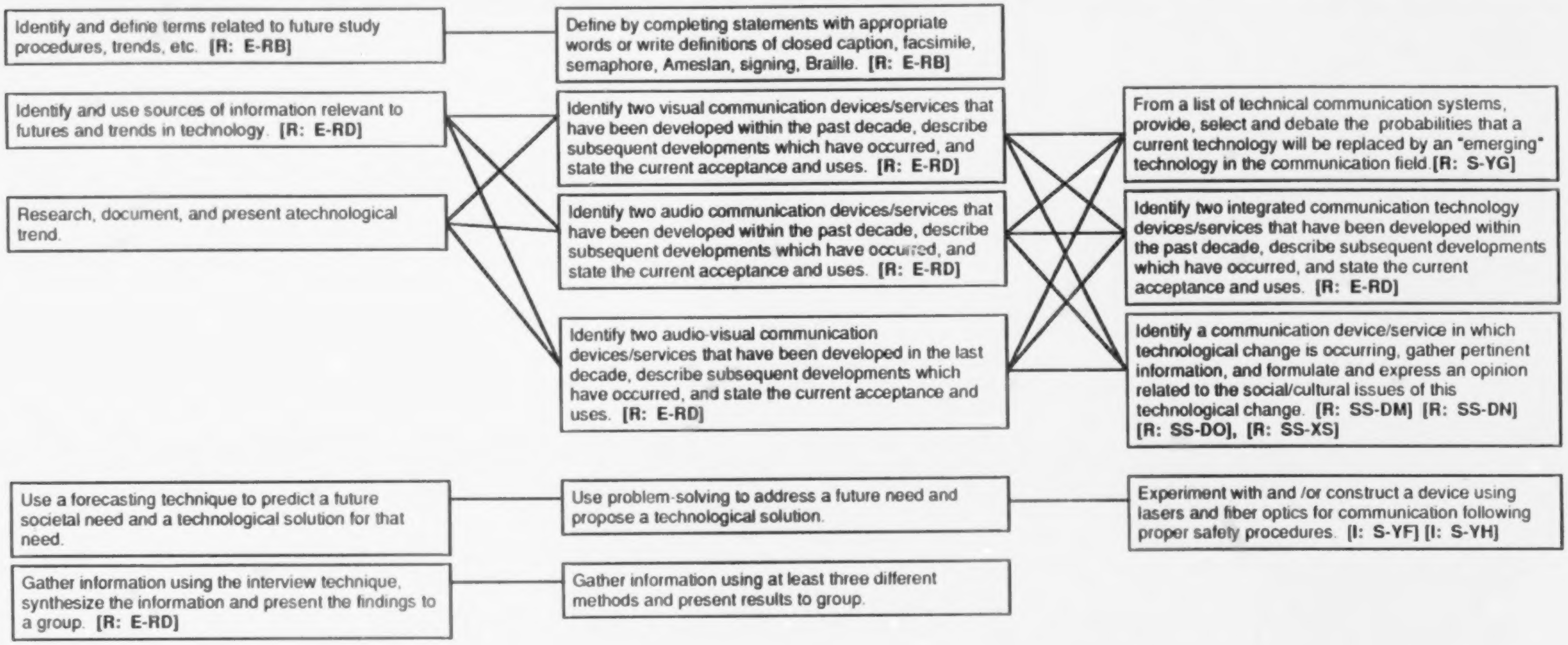
Static Communication (continued)

Level 2 Introduction	Level 2 Exploration	Level 3 Intermediate
Distinguish among tactile, olfactory and gustatory sensory perceptions	List three examples each of three-dimensional graphic symbols/messages, non-graphic visual signals, and light signals for visual communication. **[I: E:OH] [I: E:OJ]**	
	Give three examples each of musical instruments and non-electrical sounds used in audio communication. **[I: E:OH] [I: E:OJ]**	
	Give two examples each of texture, movement, temperature and location/sequence used in tactile communication. **[I: E:OH] [I: E:OJ]**	
	examples each of smell and taste communication. **[I: E:OH] [I: E:OJ]**	
Recognize that all of the human senses are normally used in communicating.	Give two examples each of communication using smoke signals, deaf sign language, hand signals, and body language and communicate a specific message using one of them. **[I: E:OH] [I: E:OJ]**	
	Give two examples each of communication using on/off signals, electronically controlled signals, and human controlled signals. **[I: E:OH] [I: E:OJ]**	

Strand #8: Futures

Level 2 Introduction → Level 2 Exploration → Level 3 Intermediate

Futures



Level 2 Introduction	Level 2 Exploration	Level 3 Intermediate
Identify and define terms related to future study procedures, trends, etc. **[R: E-RB]**	Define by completing statements with appropriate words or write definitions of closed caption, facsimile, semaphore, Ameslan, signing, Braille. **[R: E-RB]**	
Identify and use sources of information relevant to futures and trends in technology. **[R: E-RD]**	Identify two visual communication devices/services that have been developed within the past decade, describe subsequent developments which have occurred, and state the current acceptance and uses. **[R: E-RD]**	From a list of technical communication systems, provide, select and debate the probabilities that a current technology will be replaced by an "emerging" technology in the communication field. **[R: S-YG]**
Research, document, and present atechnological trend.	Identify two audio communication devices/services that have been developed within the past decade, describe subsequent developments which have occurred, and state the current acceptance and uses. **[R: E-RD]**	Identify two integrated communication technology devices/services that have been developed within the past decade, describe subsequent developments which have occurred, and state the current acceptance and uses. **[R: E-RD]**
	Identify two audio-visual communication devices/services that have been developed in the last decade, describe subsequent developments which have occurred, and state the current acceptance and uses. **[R: E-RD]**	Identify a communication device/service in which technological change is occurring, gather pertinent information, and formulate and express an opinion related to the social/cultural issues of this technological change. **[R: SS-DM] [R: SS-DN] [R: SS-DO], [R: SS-XS]**
Use a forecasting technique to predict a future societal need and a technological solution for that need.	Use problem-solving to address a future need and propose a technological solution.	Experiment with and /or construct a device using lasers and fiber optics for communication following proper safety procedures. **[I: S-YF] [I: S-YH]**
Gather information using the interview technique, synthesize the information and present the findings to a group. **[R: E-RD]**	Gather information using at least three different methods and present results to group.	

5. MO ITE/TE Guide Suggested Revision Form

To maintain the value of the *ITE/TE Guide*, members of the profession are encouraged to submit suggestions for additions, revisions and other modifications of any part of this document.

Chapter #: ________ Chapter Name: ____

Part # ________ Part Name: ____

My suggestion is a: ___ Revision ____ Addition ____ Other: ____________________

My suggestion is to: (Attach pages and information as needed)

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